WIRE AND WIRE PRODUCTS

OCTOBER 1957

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ONE STANDARD ... *the highest*

for everything you require

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Cold Drawing Equipment

always "Quick on the Draw!"

THE DETAILS ARE ON PAGES 1192-A, B, C and D

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

Payoffpak®...

Continental's new way to send a wire

By automatically packaging wire as it is drawn, Continental's Payoffpak has revolutionized the handling of wire! These fibre drums put an end to small manually handled coils that are costly to produce and costly to use. What's more, the wire is untouched by dirty or sweaty hands and remains protected in the sturdy drums until ready to use. Lightweight Payoffpaks can hold 600 lbs. of wire each; high stacking strength means you can save on storage space too.

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THE MANUFACTURERS OF

"America's Finest Wire Drawing Lubricants"

Cordially invite you to spend your "leisure" hours with us in Suite 208-209-210 at the LaSalle Hotel during The Wire Association Convention, Oct. 14th through Oct. 17th.

We have planned many things for your enjoyment.

Standard Industrial has pioneered in most of the outstanding contributions to better wire drawing through better lubricants. Consult Standard Industrial for the solution of your difficult problems.

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SILVER COATED COPPER WIRE

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Silver and False Gold Coated Copper—Aluminum Slit-foil for Tinsel Ribbons and Garlands.

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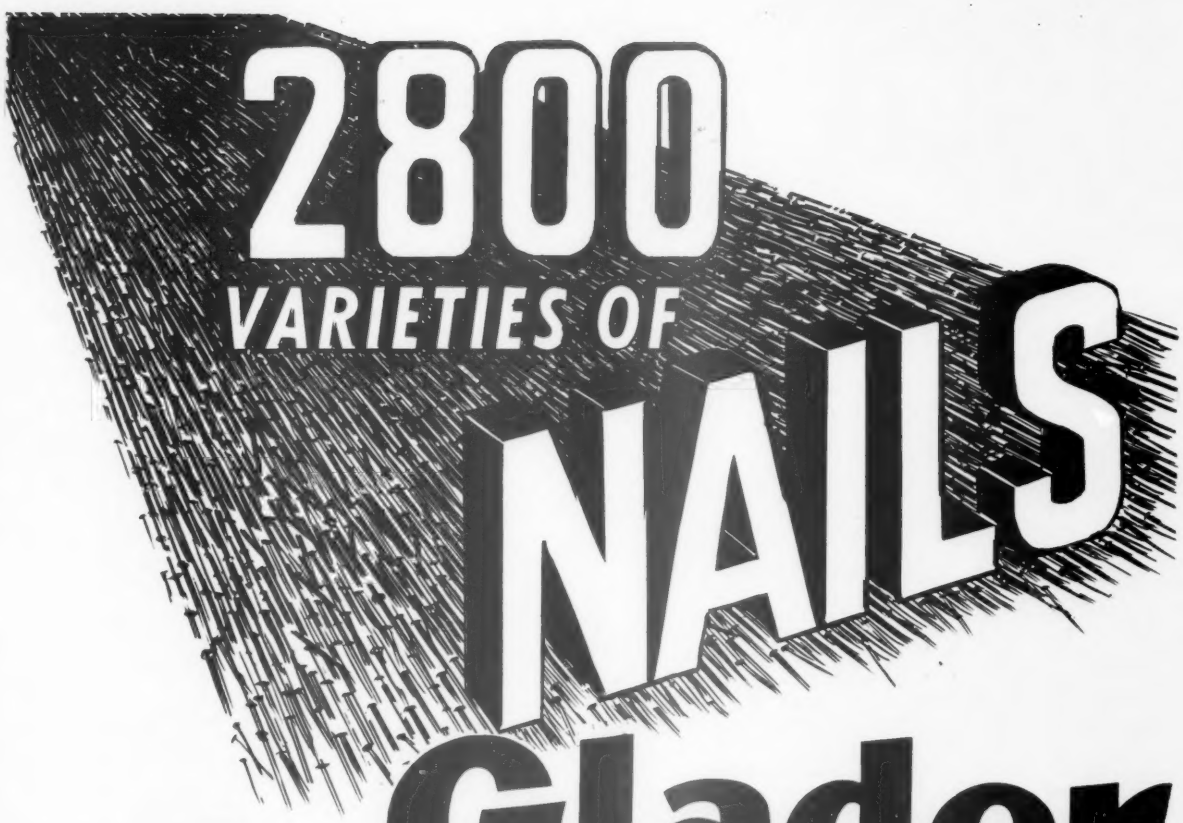

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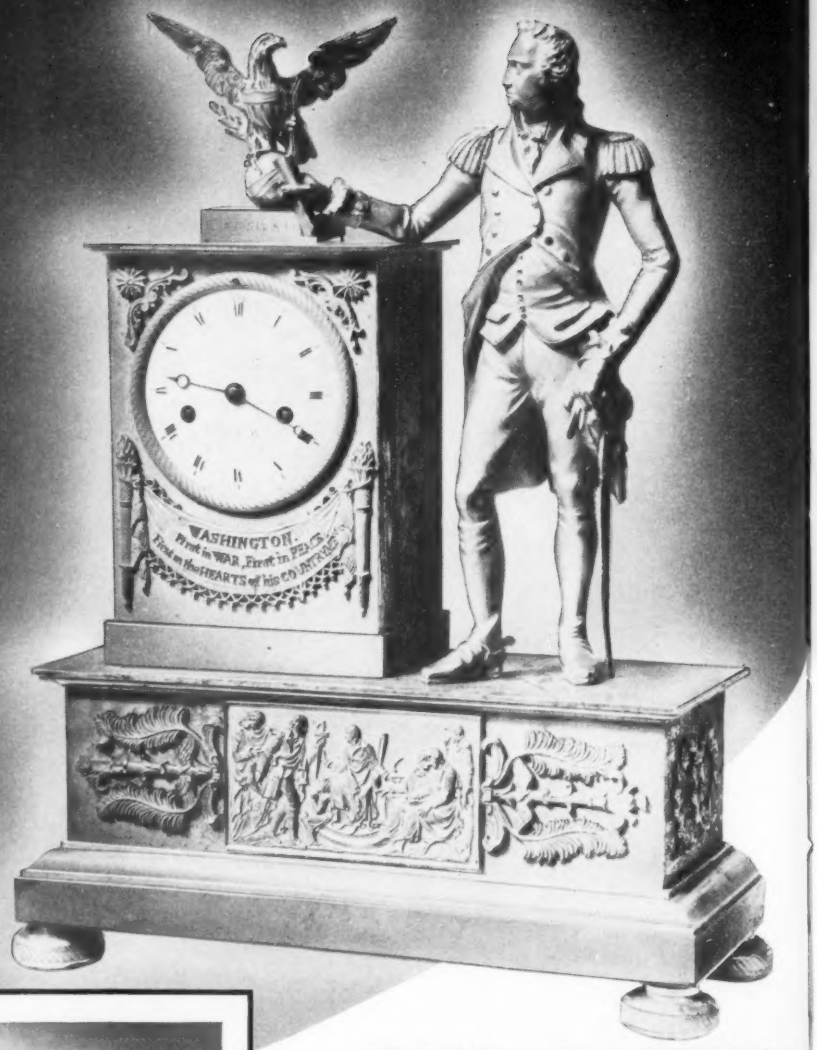
THAT IS SUPERIOR

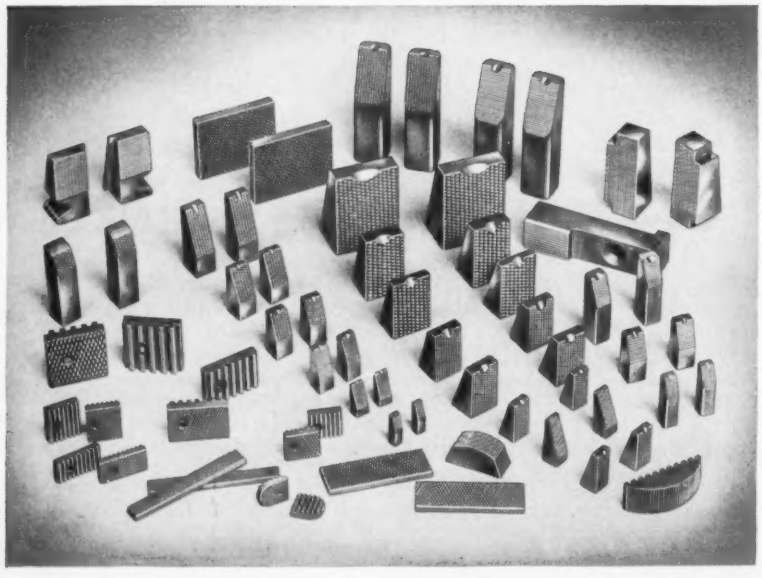
Although we have taken advantage of every new development in equipment and processing, Sjogren recognizes that nothing can take the place of sheer craftsmanship . . . when it comes to metalworking.

The skill and pride of the old masters, evident in the handiwork of this famous builder of clocks, has an intrinsic value far beyond its monetary worth.

Skill and pride are also behind the planning and production of Sjogren wire mill tools and special machinery — to the extent that here too, is found an intrinsic value far beyond the purchase price.



This French clock is a fine example of metalworking artistry in bronze. It was designed by Dubric — and is decorated with the figure of George Washington: Now shown at Metropolitan Museum of Art, New York. Photo "Bettman Archive".



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Sjogren JAWS

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WIRE AND WIRE PRODUCTS*

Reg. U. S. Pat. Off.

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 32 October, 1957 No. 10

Designated as Official Publication By The Wire Association

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THE COST
OF A TOOL UNTIL
YOU HAVE TO
REPLACE IT!

UNLIKE SOME TOOLS

CAREW
CUTTING NIPPERS

don't have 1000 uses. They are made only for cutting wire.

CAREW NIPPERS will continue to do this year after year; cutting efficiently long after most tools have been junked.

MADE IN 4 SIZES
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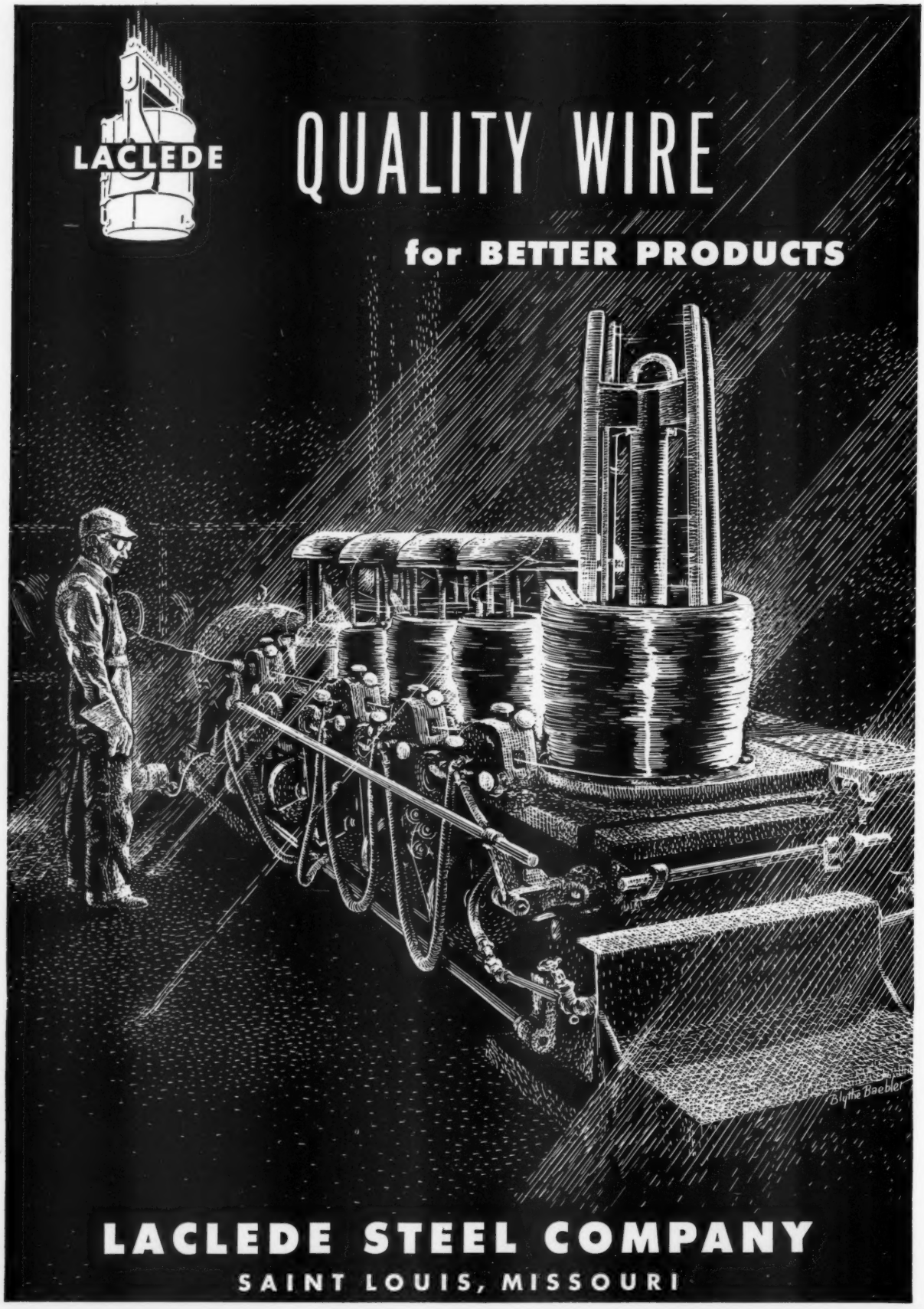
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for BETTER PRODUCTS
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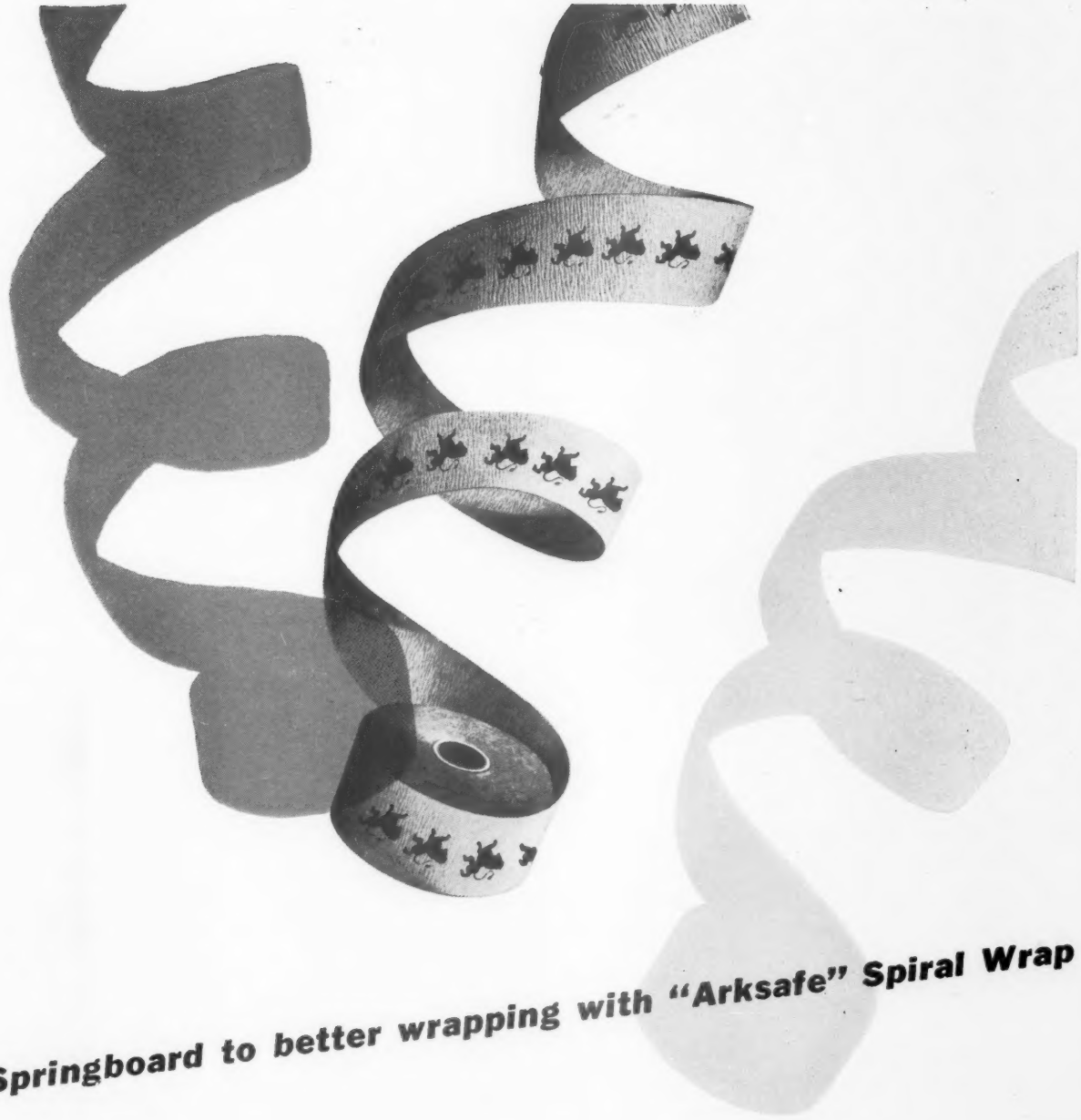

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For coils, bars, rods and tubings, colorfully printed "Arksafe" spiral wrap offers all the advantages associated with quality packaging... constructed to insure product protection... printed to attract attention and "be remembered"... priced to make its use practical, your operations profitable.

Why accept less?

EST. 1896

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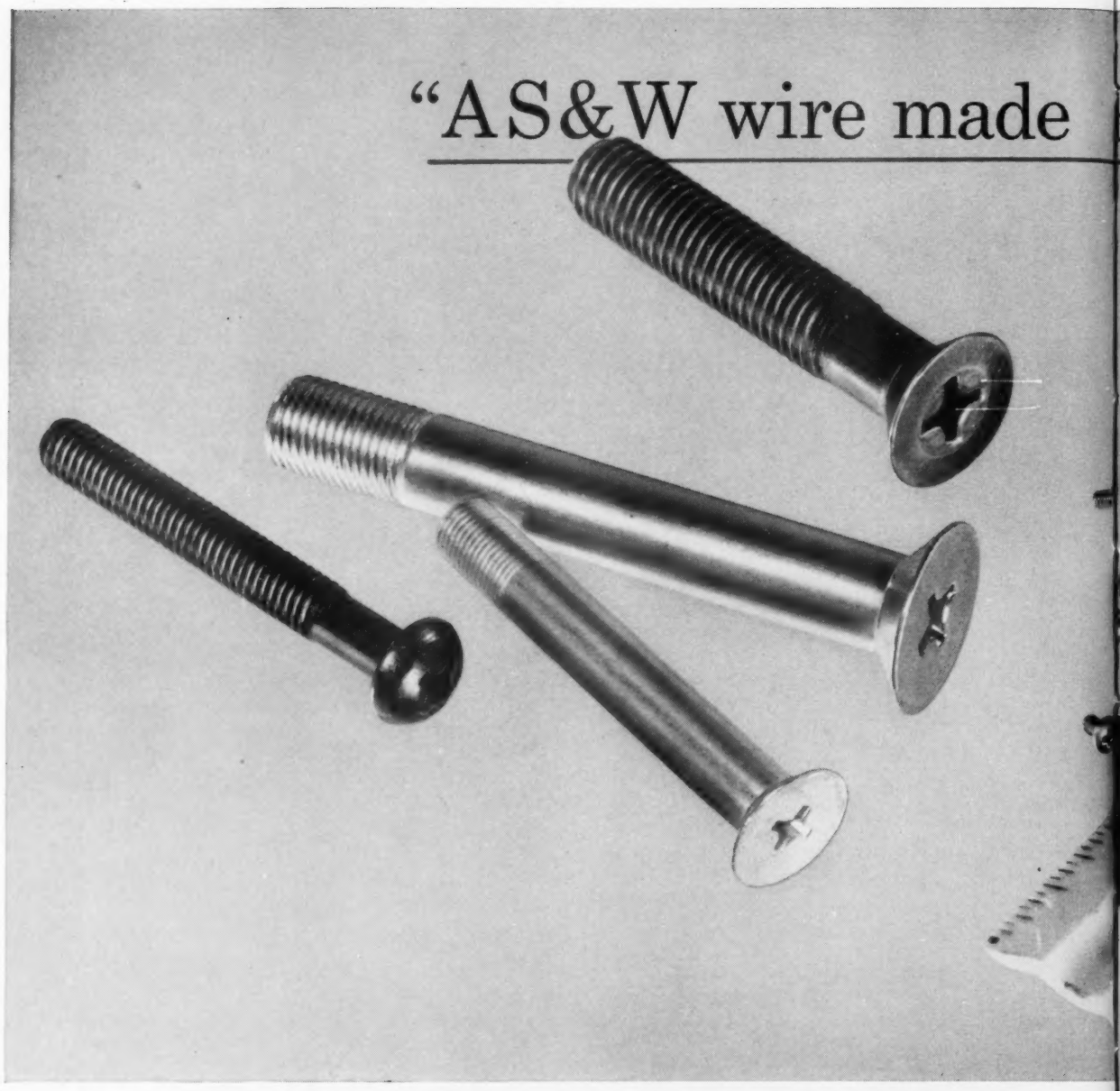

Some typical Phillips head fasteners. Notice the well-defined Phillips punch impression, made with one blow in cold steel.

Typical bank of cold-heading machines. Impression of the Phillips punch is such a severe operation that punches may last from one to several hours.

Phillips fasteners possible,"

says American Screw Company
Willimantic, Conn.

American Screw Company is the largest manufacturer of recessed head fasteners. They produce several million pieces a day, in thousands of different varieties, using many tons of highest quality cold-heading wire.

We're all familiar with the Phillips head fastener. Consider for a moment the production problems involved in making it. In a high-speed, two-blow, cold-heading machine, the wire is cut and cold forged into a blank in the first operation. Then, in the second step, the preformed head is impressed with the Phillips punch. The wire must be hard enough not to buckle; but at the same time, it must be soft enough to flow and fill out the head without splitting—even when the Phillips punch slams into it.

For years, we worked to develop a wire that would withstand the relentless pounding of the Phillips cold-heading machines. We developed a highly engineered method of annealing the wire, then drawing it slightly to work-harden it. It was hard on the outside (no buckling), soft on the inside (easy flowing), clean as a whistle and free from surface imperfections.

We would be tempted to say that this was strictly an American Steel & Wire development . . . but it wasn't. Factually, the development of "Phillips Quality Wire" was a cooperative effort between the men at AS&W and American Screw. It took a long time, but it paid off with beneficial results that have radiated to every industry that has a fastening problem.

There is nothing we'd like better than a chance to cooperate with you to help work out some of *your* wire problems. Just call your AS&W salesman.

AMERICAN STEEL & WIRE DIVISION
UNITED STATES STEEL, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO,
PACIFIC COAST DISTRIBUTORS • TENNESSEE COAL & IRON DIVISION,
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Checking a coil of AS&W "Phillips Quality Wire." All wire is bought to finished size. It is shipped coated, ready for heading.

USS AMERICAN MANUFACTURERS WIRE

USS

AMERFINE —*high-quality fine wire.*
AMERSPRING —*music steel spring wire.*
AMERTEMP —*heavy-duty oil-tempered wire.*
AMER-LED —*leaded steel.*
AMERLOY —*alloy heading wire.*
AMERHEAD —*uniform heading wire.*
AMERSTITCH —*extra-tough metal stitching wire.*
STAINLESS STEEL —*wire and strip.*

UNITED STATES STEEL

High Efficient Wire Rod Wet Drawing Machine

Type HKW

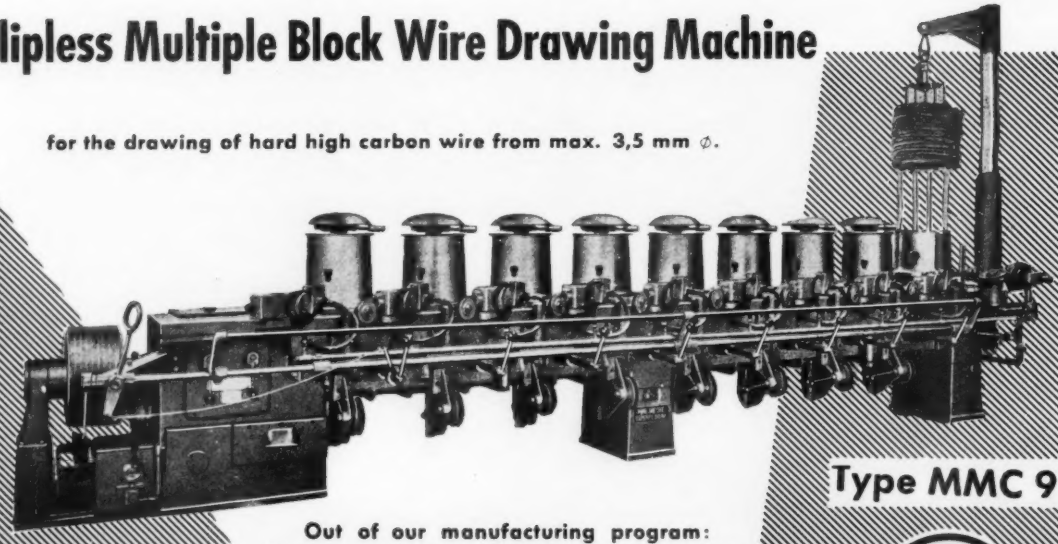
for the drawing of copper wire from max. 12 mm, aluminium wire from max. 18 mm ⌀.

Out of our manufacturing program:
Wet Drawing Machines (Tandem and stepped cone arrangement).

MALMEDIE & CO · MASCHINENFABRIK · GMBH · DÜSSELDORF

Slipless Multiple Block Wire Drawing Machine

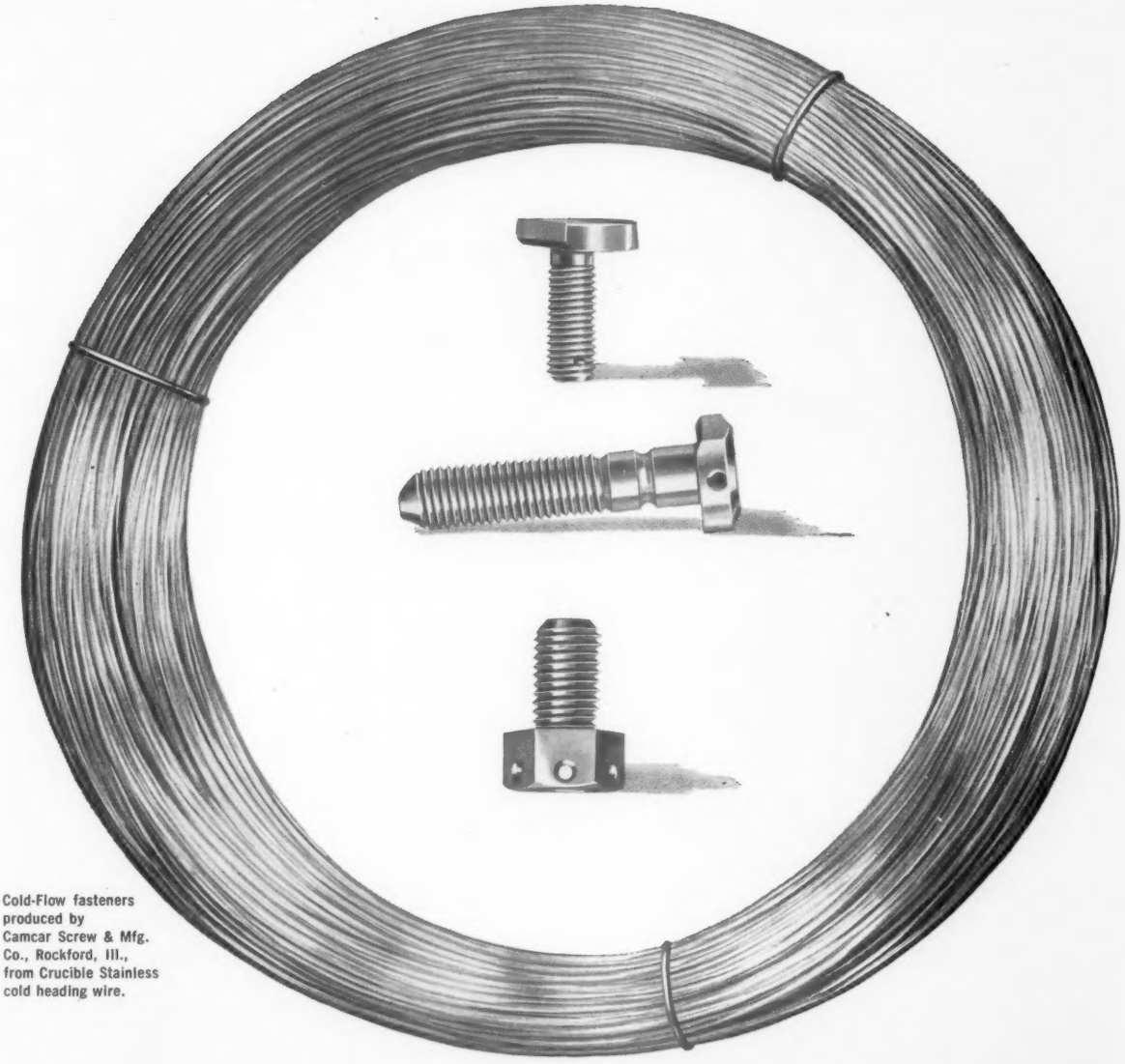
for the drawing of hard high carbon wire from max. 3,5 mm ⌀.



Type MMC 9

Out of our manufacturing program:
Slipless Multiple Block Wire Drawing Machines for low carbon and high carbon wire within the working range from 10 to 0,3 mm ⌀.

MALMEDIE MASCHINENFABRIK GMBH · DÜSSELDORF



Cold-Flow fasteners produced by Camcar Screw & Mfg. Co., Rockford, Ill., from Crucible Stainless cold heading wire.

fast delivery–wide selection on CRUCIBLE STAINLESS STEEL WIRE

Shipments are prompt on all standard types of Crucible stainless wire—including cold heading, spring, welding, and fine wires. And you have your choice of the widest assortment of grades, sizes and finishes.

You're sure, too, of stainless wire that is structurally sound and uniform in hardness, sufficiently ductile to make forming easy, and with proper physicals to meet your specifications.

Crucible has the right wire for your job. Your nearby Crucible representative will be glad to arrange for fast deliveries. Tell him your needs. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Canadian Distributor—Railway & Power Engineering Corp., Ltd.

Patented Aug. 3, 1943

Glass Insulation Wire Covering Machine No. 805.
With Electric Heated Varnish Baking Oven.

Drum Take-up No. 1174. For use at the Enameling Operation. Also built in multiple units.

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WE SPECIALIZE IN MACHINERY FOR:
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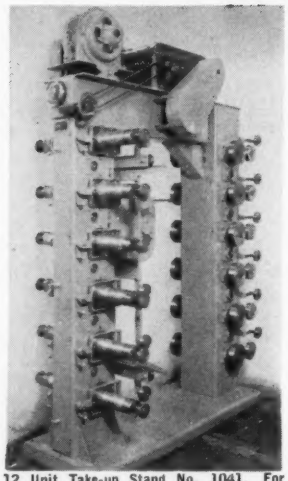
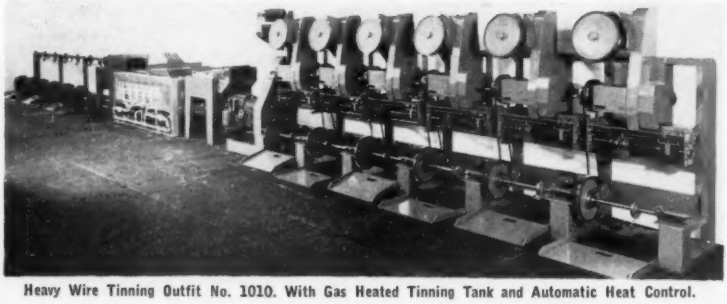
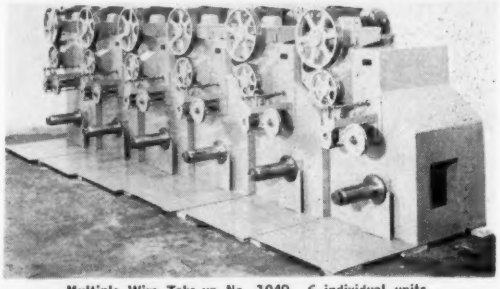
TINNING, INSULATING, TAPING,
GLASS-COVERING, PANNING,
AND ALLIED MACHINERY



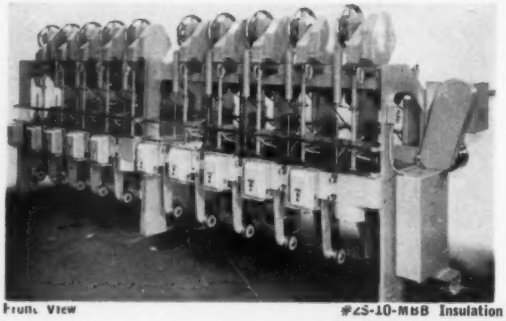
12 Unit Take-up Stand No. 1041. For use in wire tinning outfits, etc.



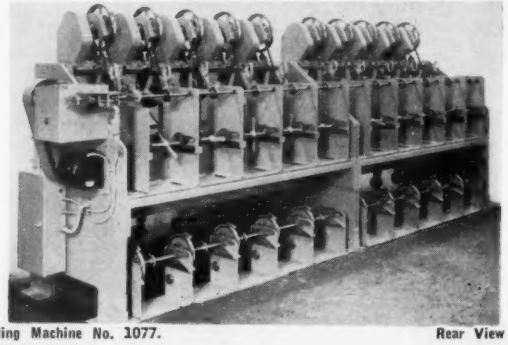
Heavy Wire Tinning Outfit No. 1010. With Gas Heated Tinning Tank and Automatic Heat Control.



Multiple Wire Take-up No. 1049. 6 individual units, each Reel-arbor torque motor driven. For use in wire tinning outfits, etc.



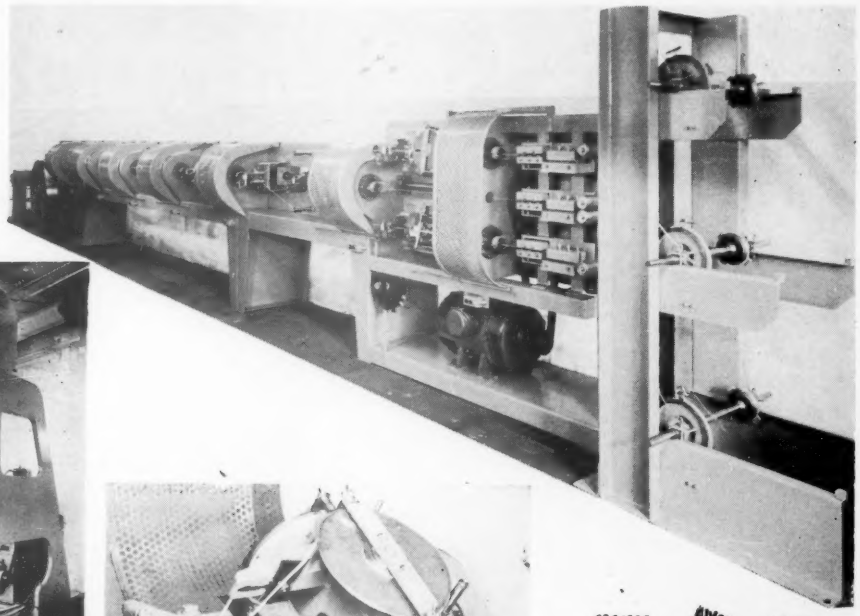
Front View

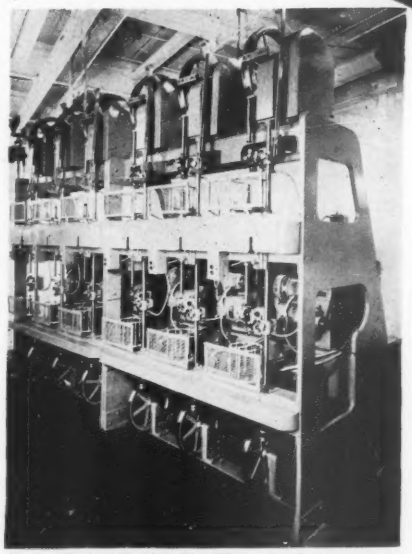


#25-10-MBB Insulation Winding Machine No. 1077.
Applies a single cover to 10 lines of wire.

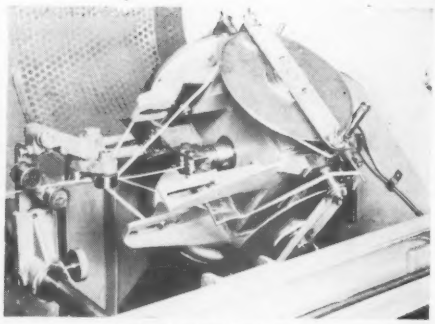
Rear View

4 M-T-BB Taping Machine No. 1105. Arranged for individual wire double taping, then combining and multiple tape covering.





Double Taping Machine No. 1107. Applies 2 tapes to each of 6 round or flat wires.

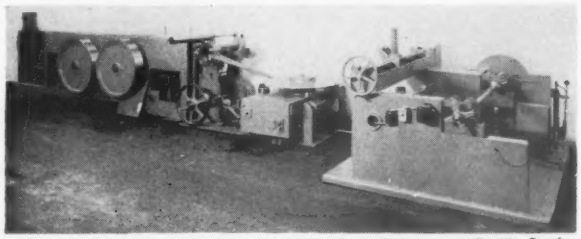


Quadruple Taping Head No. 889.

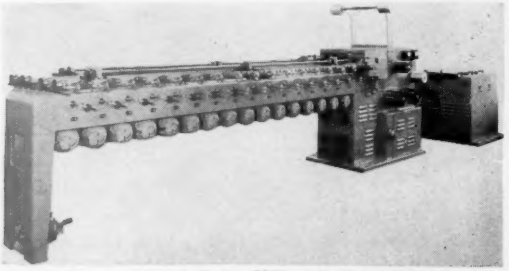
EST. 1888 AIMco INC. 1918

"American" INSULATING MACHINERY COMPANY

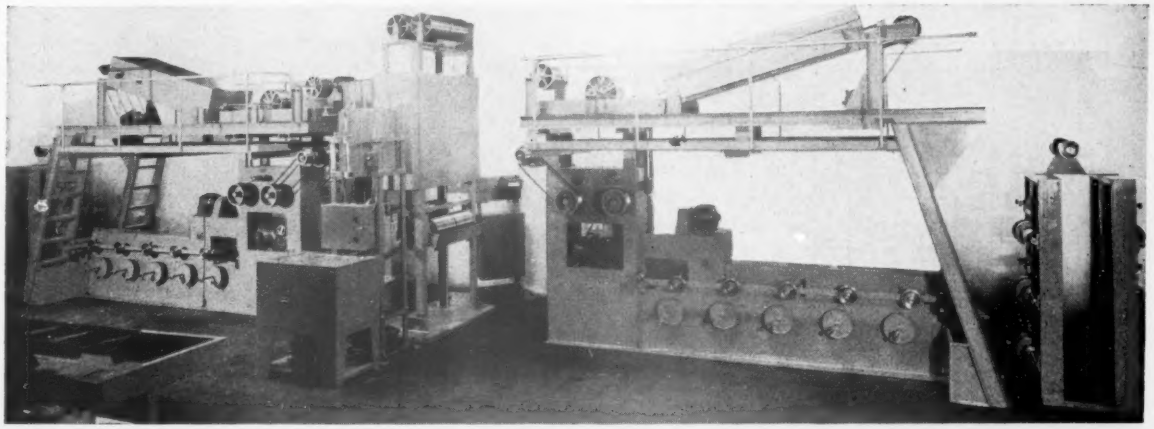
REFER TO NUMBERS



Combination Wire Panning Machine No. 1068. Drum Take-up and Double Capstan with Adjustable Speed Drive.



32 Unit Take-up with Let-off No. 1178. Let-off and Take-up capstan speeds are synchronized. Take-up spindles are Torque Motor driven.



Wire Enameling Machine outfit No. 997. With Pre-annealer, Storage, Circulating and Filter System for Enamel. Oven is higher than shown and is shortened to show top sheaves.

U.S.I.

Vol. II, No. 5

POLYETHYLENE PROCESSING TIPS

HOW CARBON BLACK QUALITY AFFECTS WEATHER RESISTANCE OF POLYETHYLENE

For cable jacketing and many other outdoor applications polyethylene offers substantial advantages over other materials. It is subject, however, to degradation from long exposure to sunlight unless the resin is properly protected.

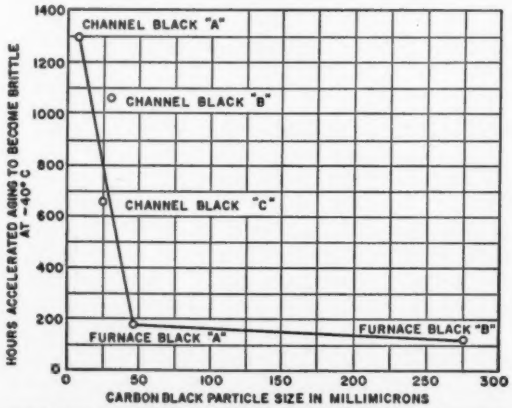
Actually, the aging of polyethylene is the result of a chemical reaction with atmospheric oxygen. Catalyzed by the ultraviolet rays in sunlight, this reaction proceeds more rapidly in outdoor use than is the case with indoor applications. The principal effects of aging are to increase brittleness at low temperature, and to decrease the resistance to stress cracking.

Carbon black dispersed throughout the polyethylene greatly retards this aging, or weathering. However, not all carbon blacks produce the same degree of weather resistance when dispersed in polyethylene. Moreover, the care with which the carbon black is dispersed in the polyethylene is vitally important.

The weather resistance of a polyethylene compound depends on: (1) type and particle size of carbon black; (2) percentage of carbon black in the compound; (3) the dispersion of the carbon black in the polyethylene.

Accelerated aging tests have been devised to approximate the action of years of outdoor exposure.

The graph below shows the great difference in number of hours required in these tests for a polyethylene to embrittle at −40°C when various carbon blacks having different particle sizes are used.



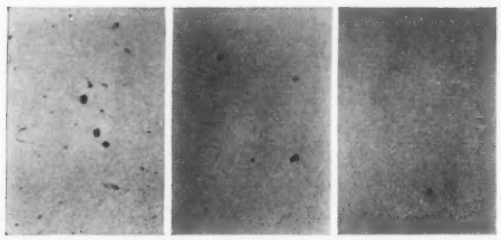
EFFECT OF CARBON BLACK PARTICLE SIZE ON ACCELERATED AGING OF POLYETHYLENE.

The two at right are "furnace blacks", and it will be noted that they are comparatively ineffective. The three at the left are "channel blacks", and obviously, they are many times more effective. This is due to their much smaller particle size – from about 10 to 25 millimicrons, against 50 to 275 millimicrons for furnace blacks.

Weather resistance also increases with the concentration of carbon-black – up to a point. Beyond this point the light screening effect is offset by a decline in other properties.

DEGREE OF DISPERSION IMPORTANT

Carbon black gives maximum protection only when it is thoroughly dispersed in the polyethylene. This presents a difficulty because the smaller the particles, the greater is their tendency to collect into clusters which, once formed, are hard to break up. Tests show that a good dispersion will withstand 15 to 20 times as much exposure to sunlight as a poor dispersion.



POOR FAIR GOOD

MICROPHOTOGRAPHS OF CARBON BLACK DISPERSIONS IN POLYETHYLENE.

The wire and cable grades of U.S.I.'s PETROTHENE polyethylene resins employ only the finest "channel black" carbon black. Concentration is set at a point which yields the optimum balance of light screening and other properties. Special processing equipment insures thorough dispersion. The result is black polyethylene that withstands long, severe outdoor exposure, yet affords the practical maximum of tensile and other properties.

If you fabricate or use black polyethylene, ask U.S.I. for complete technical data on PETROTHENE resins expressly formulated for weather resistance.

U.S.I. INDUSTRIAL CHEMICALS CO.
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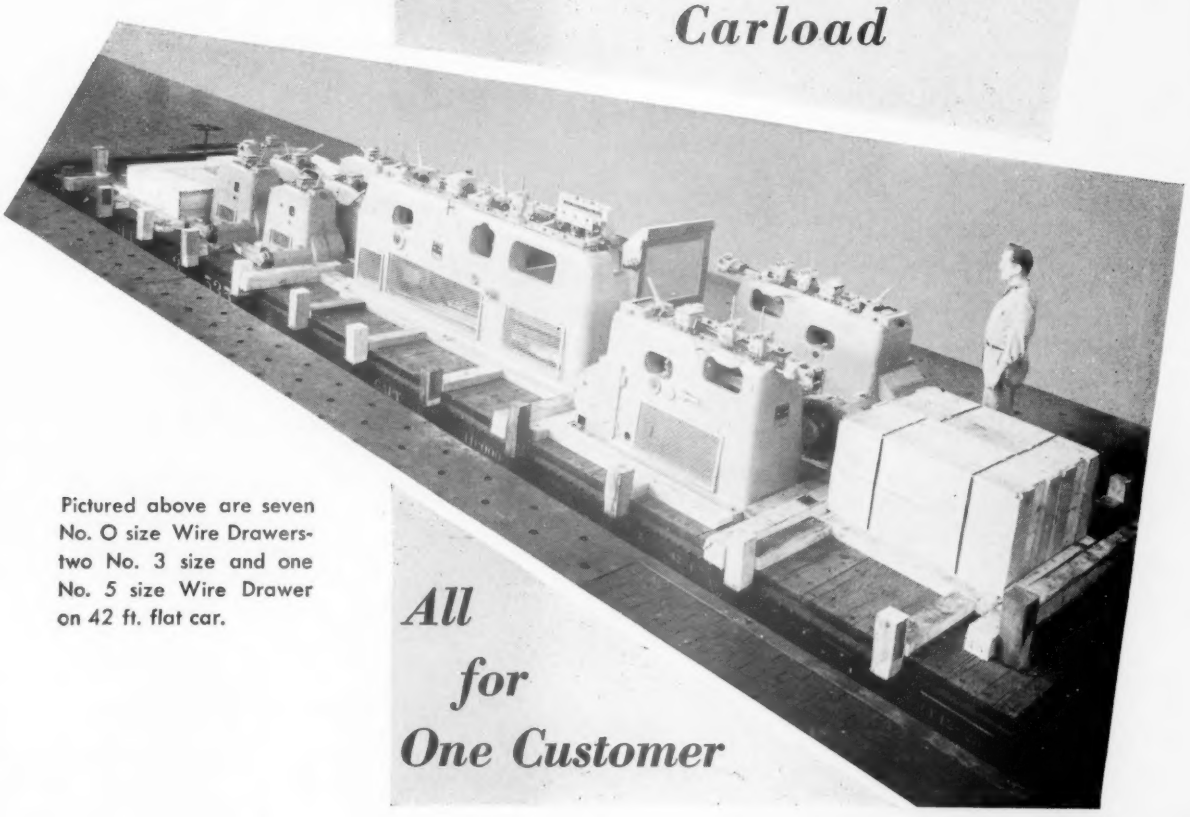
Ajax-Hogue

Wire Drawers by the Carload



Pictured above are seven No. O size Wire Drawers-two No. 3 size and one No. 5 size Wire Drawer on 42 ft. flat car.

All for One Customer

One of the larger cold heading plants will attach these Ajax Hogue Wire Drawers to ¼", ½" and ¾" bolt makers.

If you have cold headers or bolt makers you, too, can attach Ajax Hogue Wire Drawers to your machines and take advantage of lower material costs - straight & accurate wire blanks - easier heading - increased header die life and improved products.

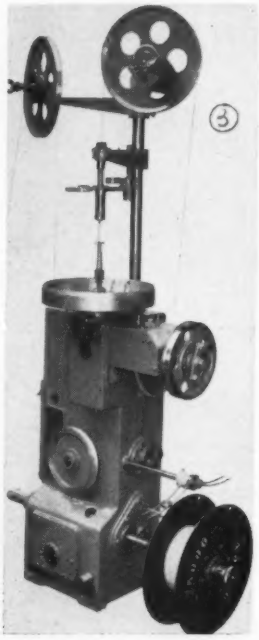
Write for Bulletin 111-A

THE Ajax MANUFACTURING COMPANY
EUCLID BRANCH P. O. CLEVELAND 17, OHIO
110 S. DEARBORN ST., CHICAGO 3, ILLINOIS
W. P. WOOLDRIDGE CO. • BURLINGAME, CAL. • LOS ANGELES 22, CAL.

NEW...

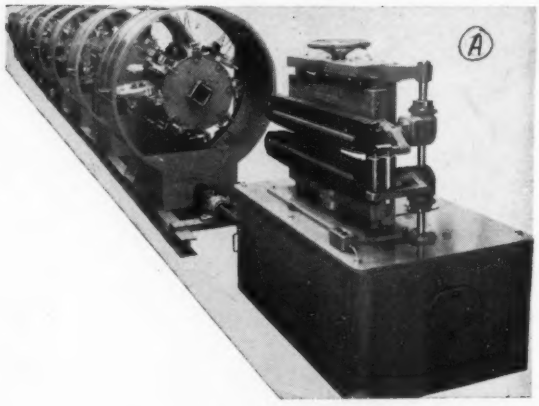
IN PAPER LAPPING

FOR TELEPHONE WIRES



— High speed paper lapping.
— 3,000 r.p.m.
— Movable drum.
— Automatic stop.
— 12" pad.
— Electric counter.
— Central lubrication.

FOR HIGH VOLTAGE CABLES



— 8 x 20" pads per head.
— Constant tension.
— Extensible pad centre.
— Individually braked.
— Variable die.
— Caterpillar haul-off.
— P.I.V. drive.
— Automatic stop.

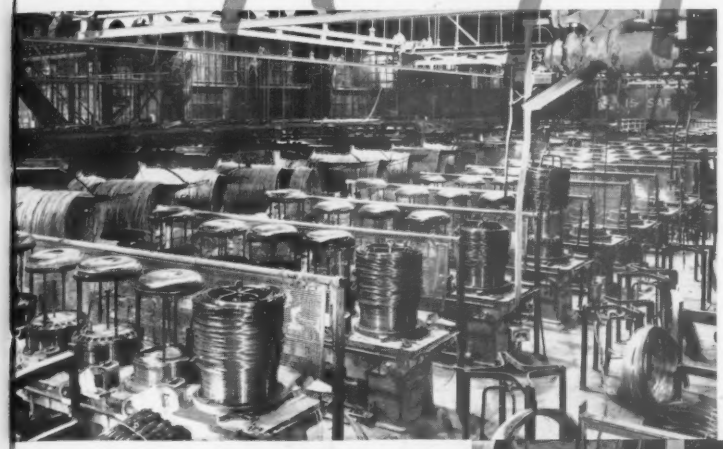
For further details, please address:

POURTIER MACHINES

153, rue Général Galliéni

ROMAINVILLE (Seine) FRANCE

EACH INSTALLATION *A top producer!*



Yes, the proof is in the production—and Morgan-Connor Wire Machines have an international reputation as high volume producers.

The Morgan-Connor all air-cooling method and no-slip storage principal rapidly remove heat from the wire. Exacting specifications are met at high speeds.

Sheffield Steel Division
Armco Steel Corp.
Kansas City, Missouri

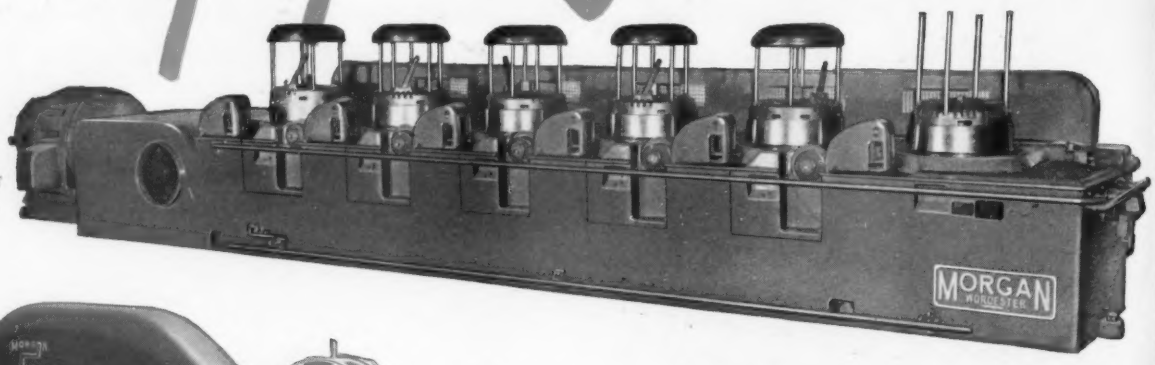
Laclede Steel Company
Alton, Illinois

Wickwire Spencer Steel Division
Colorado Fuel and Iron Corp.
Palmer, Massachusetts

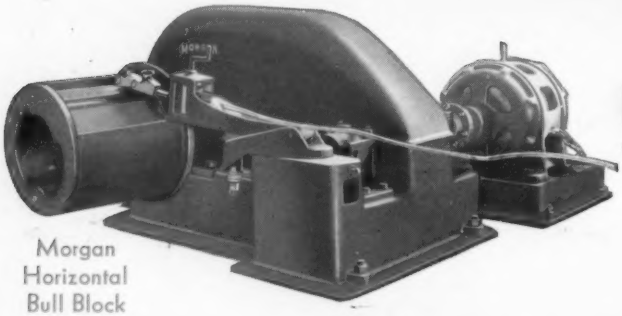
MORGAN-CONNOR
WIRE MACHINES

TURN TO MORGAN-CONNOR MACHINES

EVERY MACHINE *A top performer!*

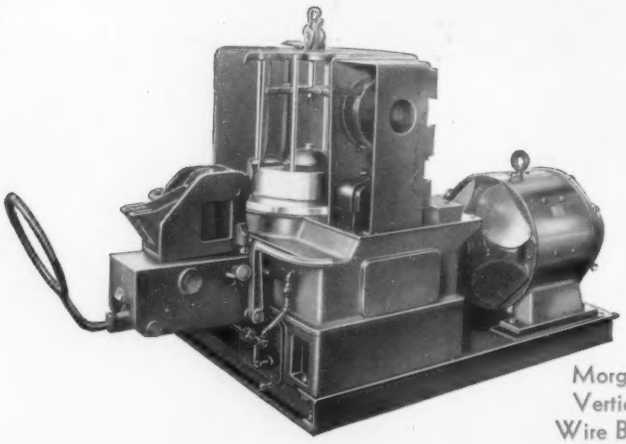


Type BW
Morgan-Connor
Wire Machine



Morgan
Horizontal
Bull Block

Economy of Floor Space



Morgan
Vertical
Wire Block

High Production

ew—Morgan
Dead Block

Long Die Life

Safety afforded the Operator

MORGAN-CONNOR
WIRE MACHINES

Morgan Construction Company WORCESTER, MASS.

ROLLING MILLS • MORGOIL BEARINGS • REGENERATIVE FURNACE CONTROL • EJECTORS • GAS PRODUCERS

NEW AUTOMATION IN WIRE DRAWING

WHEELABRATOR®

Mechanical Descaling of Hot Rolled Rod Eliminates Pickle Line

Three installations in Cleveland mark the first application of the Wheelabrator process of mechanical descaling of hot rolled rod in line with a draw bench. No pickling is required. These combination cleaning and drawing lines produce wire for cold header operation in the production of high-quality bolts, nuts, etc.

In the operation of this line, successive coils are welded together to form a continuous strand of rod. By means of sheaves, the rod passes through the Wheelabrator Cabinet twice at speeds up to 400 fpm. At the draw bench, 2,500-lb. coils are removed and sent to the cold headers.

Two other companies have adopted the Wheelabrator process to eliminate pickling. They are installing blast cleaning units in line and after a patenting furnace to clean high-carbon rod. Thus coils of annealed and cleaned rod can go directly to the wire mill, bypassing the pickle house. These new lines will operate in the same manner as present patenting lines except, by incorporating an automatic Wheelabrator, cleaned and coated rod is produced ready for drawing into wire.

Write today for complete information.

full details at convention

Detailed factual data covering the first operation of this process as described above will be presented in a paper to be given to the National Convention of the Wire Association in October.

WHEELABRATOR
CORPORATION

389 South Byrkit Street, Mishawaka, Indiana

WORLD'S LARGEST MANUFACTURER OF AIRLESS BLAST CLEANING EQUIPMENT

ACP Granodraw® Processes ELIMINATE COSTLY LEADING AND DE-LEADING OPERATIONS IN THE DRAWING OF STAINLESS STEEL WIRE; ALSO SAVE MONEY IN OTHER DRAWING, STAMPING AND EXTRUDING OPERATIONS

IN DRAWING OF STAINLESS WIRE, ACP Granodraw SS eliminates costly leading and de-leading operations. All Granodraw coatings offer greater speed of draw, longer die life and finer finish on all types of wire.

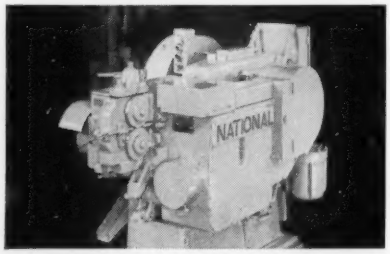
In all operations, ACP Granodraw coatings prevent metal-to-metal contact, thus eliminating galling and seizing. They act as a carrier for the lubricant, reducing friction.

In the drawing of stainless steel wire, Granodraw SS® is particularly effective. It eliminates costly leading and de-leading operations, has these plus advantages over lead:

- **Is easier to apply**
- **Is easier to remove**
- **Minimizes loss of metal by eliminating lead pickup and intergranular breakdown**
- **Eliminates health problems inherent in the handling of lead**
- **Cuts process time**
- **Offers a straightline cleaning process that completely removes all coating**
- **Eliminates contamination problems**

ACP Granodraw coatings—Granodraw for steel, Granodraw SS for stainless—also mean greater speed of draw, greater total reductions, longer die life, fewer process anneals, and less pickling. They produce finer finishes, afford easier inspection of finished product, and give more effective lubrication.

ACP GRANODRAW	Type of Coating	Type of Metal Treated	Method of Application	Typical Applications
No. 1	Zinc phosphate	Steel	Dip (tanks)	Bumper Forming Deep Drawing Cold Extrusion Wire, Rod, Tube
No. 2	Zinc phosphate	Steel	Dip (tanks)	Bumper Forming Deep Drawing Cold Extrusion Wire, Rod, Tube
No. 4	Zinc phosphate	Steel	Spray (multi-stage power washer)	Bumper Forming Deep Drawing Cold Extrusion
No. 25	Zinc phosphate (microcrystalline)	Steel	Dip (tanks)	Wire and Tube Drawing
SS	Complex oxalate	Stainless Steel	Dip (tanks)	Wire and Tubing
Z	Zirconium fluoride complex	Zirconium	Dip (tanks)	Reactor Tubing



IN COLD HEADING OPERATIONS the ACP Granodraw processes have increased tool life two to fivefold in forming steel fasteners. And rejects of finished products are reduced.

LEARN MORE ABOUT ACP GRANODRAW PROCESSES. Bulletin 1437 describes the advantages and gives information which will help you select the proper type for your particular application. Write for your copy today.

CHEMICALS ACP PROCESSES

AMERICAN CHEMICAL PAINT COMPANY, Ambler 30, Pa.

DETROIT, MICH. • ST. JOSEPH, MO. • NILES, CALIF. • WINDSOR, ONT.

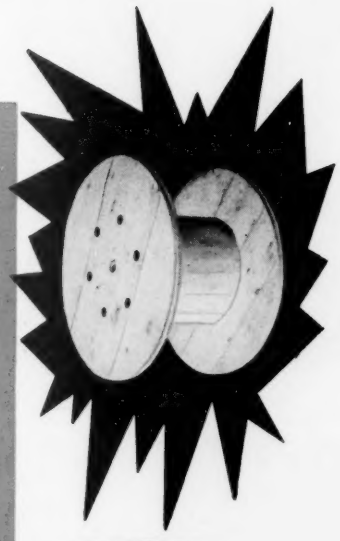
New Chemical Horizons for Industry and Agriculture

NON-RETURNABLE

WOOD REELS IN ALL SIZES FOR ALL TYPES OF ELECTRIC WIRE AND CABLE . . .

B. J.—
This looks interesting to us in Production. Suggest you investigate Bridge Reels today. Advise me when you hear from Bridge
A. F. G.

YES

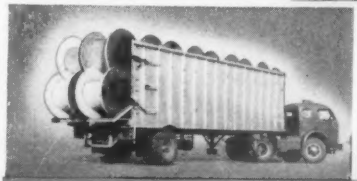


YOU SAVE WITH NON-RETURNABLES

LOOK AT THE ADVANTAGES

- **Reduce Reel Investment**
- **Less Storage Space**
- **Lower Freight Cost**
- **No Bookkeeping**
- **No Repair Costs**
- **No Return Freight**
- **No Deposit**
- **No More Headaches**

NON-RETURNABLE REELS GIVE YOU A DEFINITE PACKAGING COST



HIGH-SPEED
SHIPPING SERVICE IN OUR OWN TRUCKS

within a radius of 200 miles from the plant. Fast freight will bring you Bridge reels within a few days east of the Mississippi.

BRIDGE

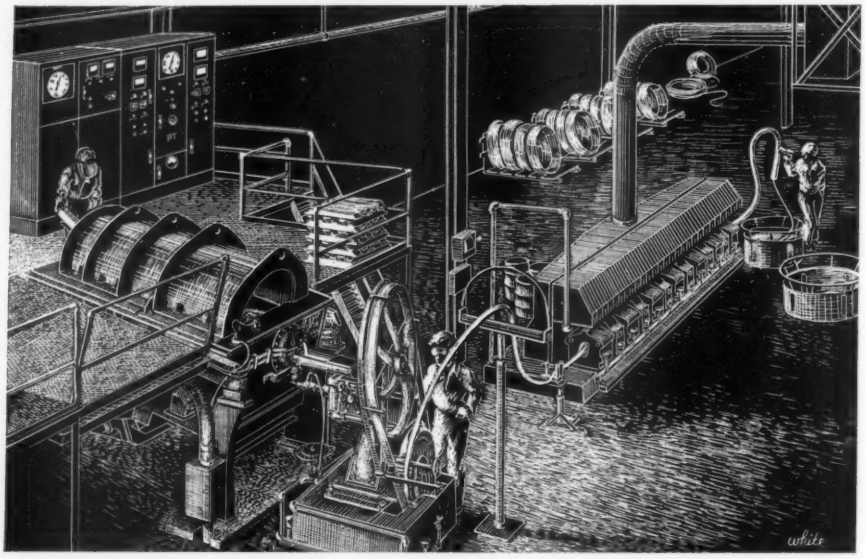
MANUFACTURING COMPANY
HAZARDVILLE, CONNECTICUT
Telephone . . .
Thompsonville, Connecticut
Riverview 9-8308

"REEL GOOD . . .

Let us quote on your reel needs. Send us your specifications. Better yet, visit our plant and see how and why Bridge reels are made so well at so low a cost.

WOOD REELS"

From Molten Aluminum to 3/8" Diameter Rod in 1½ Minutes!



Rome Cable Corporation

uses **AJAX INDUCTION FURNACES** for

MELTING ALUMINUM FOR CONTINUOUS CASTING AND ROLLING OF HIGH CONDUCTIVITY ROD

The picture above, a drawing made at the Rome Cable Corporation, Rome, N. Y., shows one of the most modern installations in the country for the continuous casting and rolling of aluminum rod directly from molten metal. From left to right are shown the electric controls of the adjacent 450 kW. AJAX low frequency induction combined melting and holding furnace which is pouring molten metal into the Properzi continuous casting machine in the foreground, and the rolling mill from which the coiled rod is emerging.

This installation casts at the rate of about one ton per hour. The furnace feeds a continuous stream of molten aluminum at automatically controlled temperature into a rim cavity on the slowly revolving wheel of the Properzi machine. Metal loss from pig to rod averages less than 1 pct. Mechanical properties and electrical conductivity are excellent; the material is sound and fine grained. The men work under cooler, cleaner conditions because the only heat generated is within the melt itself. Due to melting conditions inherent in AJAX furnaces, the operation is continuous and no fluxing is required.

AJAX USA

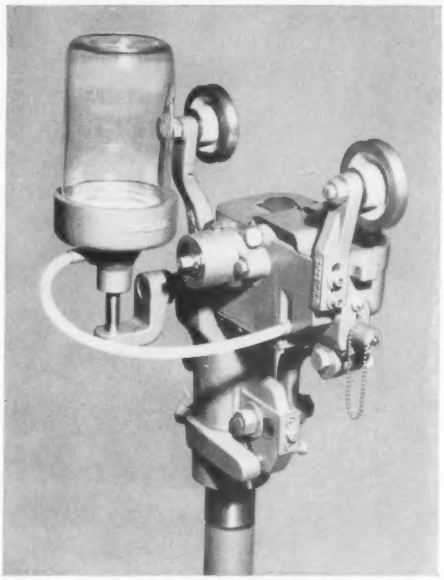
60 CYCLE INDUCTION MELTING

ENGINEERING CORPORATION

TRENTON 7, NEW JERSEY

Associated Companies: Ajax Electrothermic Corporation Ajax Electric Company

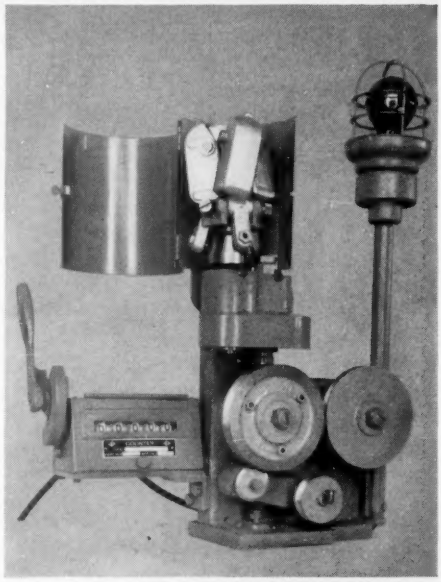
NOW – MARKING MACHINES, WHEELS, TYPE STRIPS, INKS



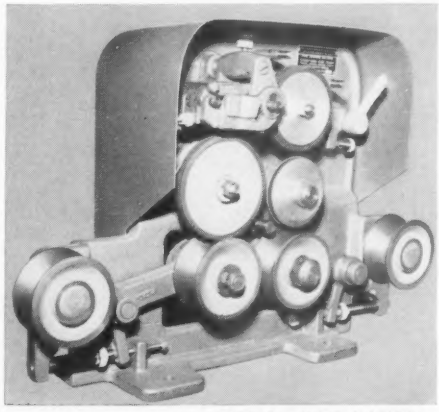
TYPE F WIRE MARKER

AVAILABLE FROM ONE SOURCE

ENTWISTLE OFFERS COMPLETE RANGE OF MARKING DEVICES TO INDIVIDUAL SPECIFICATIONS FOR BOTH RUBBER AND THERMOPLASTIC INSULATION



TYPE G SPIRAL MARKING MACHINE



TYPE A-2 WIRE MARKER

WHEELS — TYPE STRIPS

By making all marking machines and supplies available from one source, Entwistle helps simplify your ordering, makes it easier, speeds delivery. Machines can be ordered to meet your specific production problems and requirements. Printing size marks, codes, trademarks, etc. or spiral striping of wire can be done without slowing production.

TYPE F WIRE MARKER Prints or stripes on plastic wire using only one revolving printing member. Prints at extruder wire speed, eliminates re-reeling for printing.

TYPE G SPIRAL MARKING MACHINE Spiral stripes up to three different colors simultaneously. Rotated by passage of wire. Capacity from 3/64 to .20 inches wire diameter. Capacity to 5/16″ diameter can also be provided.

TYPE A-2 WIRE MARKER Prints or stripes wire and tubing. Operated by movement of wire. Prints in one color. Type strip legend made to your requirements. They provide trouble-free operation and are readily interchangeable.

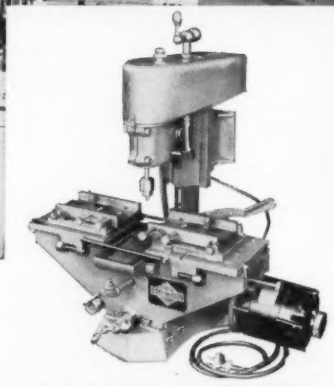
WHEELS — TYPE STRIPS Marking wheels are of chrome plated steel. Each is etched to customer's specifications. Inexpensive, economical type strips are of durable rubber bonded to a flexible steel band.

WIRE MARKING INKS Permanent, scuff-proof, resistant-proof. Will pass all present abrasion and solvent resistance tests. Available in all seven standard colors. Mixed to match your specific shades at no extra cost.

For complete details on inks and machines above, write or phone direct.

ENTWISTLE
Manufacturing Corporation
1475 ELMWOOD AVE., PROVIDENCE 7, RHODE ISLAND

This DIE room paid for itself!



Firth Sterling Nail Die Barbing Machine

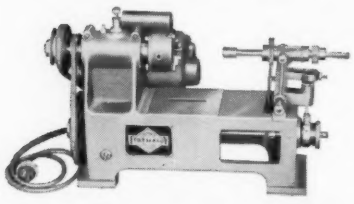
Firth Sterling can plan and equip one for you, too . . .

A well designed, well equipped and well organized die room soon pays for itself in savings resulting from longer die life, reduced downtime, smaller investment in die inventory and greater uniformity and quality of product resulting from precision tooling.

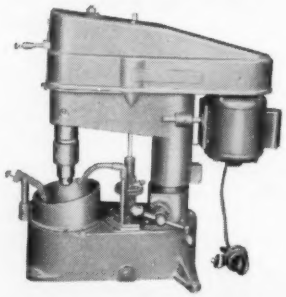
Firth Sterling, long a leader in the field with Firthaloy Dies, knows best die room practices as no other . . . and offers to the wire industry a complete die room planning and engineering service *right down to the machines to equip it.*

Firth Sterling tungsten carbide die finishing equipment is available from stock for complete tool room set-ups or as individual machines, according to your need.

Don't let an inadequate die room cost you money. Start the installation of a *modern* one by calling a Firth Sterling planning engineer. Do it now!



Firth Sterling Automatic Polisher



Firth Sterling Heavy Duty Ripper

R-315

Firth Sterling

—INC—

GENERAL OFFICES: 3113 FORBES ST., PITTSBURGH 30, PA.

MILLS: McKEESPORT, TRAFFORD, DETROIT, HOUSTON, HARTFORD
OFFICES AND WAREHOUSES*: BIRMINGHAM CHICAGO* CLEVELAND* DAYTON DETROIT* HARTFORD* HOUSTON* LOS ANGELES* PITTSBURGH WESTFIELD, N.J

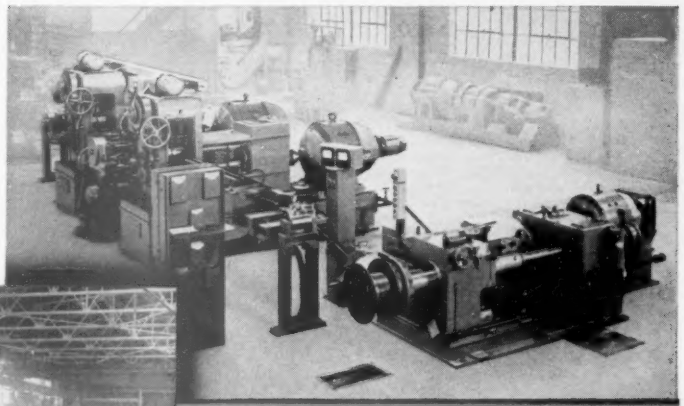
PRODUCTS OF FIRTH STERLING METALLURGY

High Speed Steels
Tool & Die Steels
Stainless Specialties
High Temperature Alloys
Sintered Tungsten Carbides
Firth Heavy Metal
Chromium Carbides
High Temperature Cermets
Zirconium

Waterbury Farrel Wire Flattening MILLS IN ACTION

Pictured here are a few of the many Wire Flattening Mills designed and built by Waterbury Farrel. Each installation was custom-engineered to fit the production requirements of each individual customer.

Whether your requirements call for a single or multiple stand mill, Waterbury Farrel can supply you with a reliable production unit that will prove to be a profitable investment.

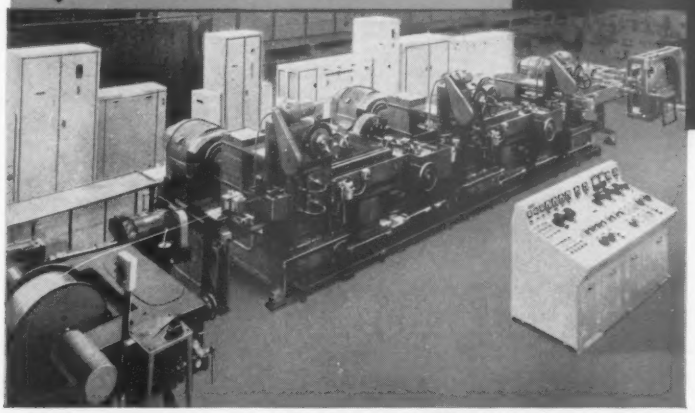


Two Stand Tandem Wire Flattening Mill at National Electric Coil Co., Columbus, Ohio. Speeds up to 1000 feet per minute.

Two Stand Tandem Wire Flattening Mill recently installed at John A. Roebling's Sons Corp., Trenton, N. J. Speeds up to 1500 feet per minute..

Three Stand Tandem Wire Flattening Mill in production for Anaconda American Brass Co. Ltd. (Subsidiary of the American Brass Co.) New Toronto, Ontario, Canada. Speeds up to 1800 feet per minute.

Three Stand Tandem Wire Flattening Mill installed at General Electric Co. in their Pittsfield Works. Speeds up to 2500 feet per minute..

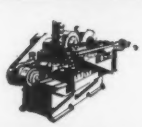


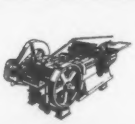
Write today for your free copy of Wire Flattening Mills, Cir. No. 731-R.

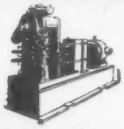
WATERBURY FARREL

THE WATERBURY FARREL FOUNDRY & MACHINE CO. Waterbury, Conn.

Sales Offices:
Chicago • Cleveland • Millburn, N. J.







Bolt, Nut & Screw Machinery • Power Presses • Rolling Mill Machinery • Wire Mill Equipment • Sendzimir Mills and other Special Machinery

WATERBURY FOUNDED 1851 FARREL

WF-32

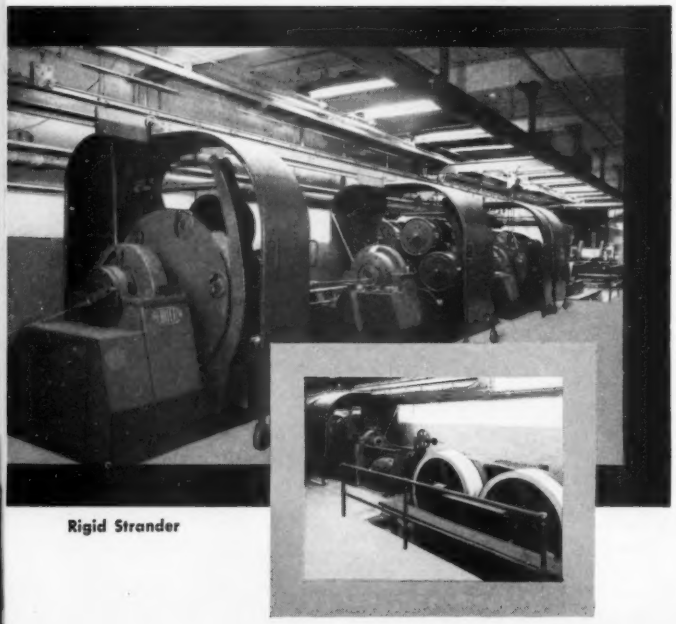
NEBUTTCO

MACHINERY

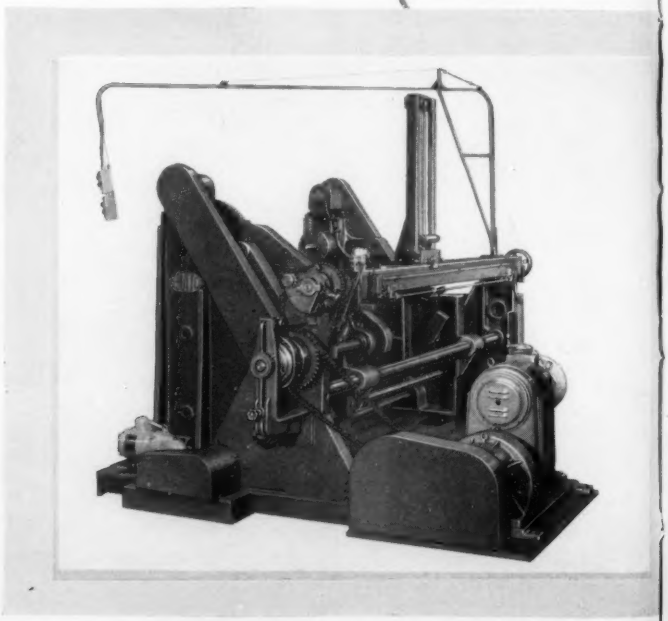
for high speed

of cables, strands and

Fast and reliable, Nebuttco Equipment is the last word in wire making machinery — ideal for profitable production of cables or strands, bare or insulated. Ask for information and literature.



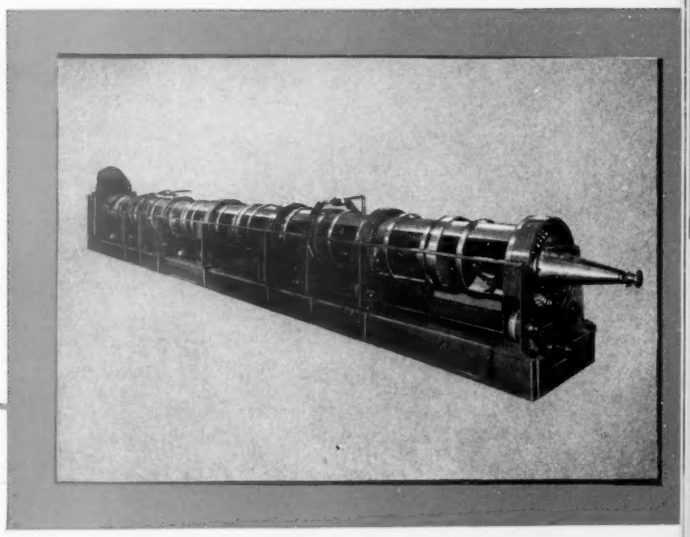
Rigid Strander



96" Shaftless Take-Up. Guard removed to show drive

7-strand Planetary Closer, for 60" x 48" reel

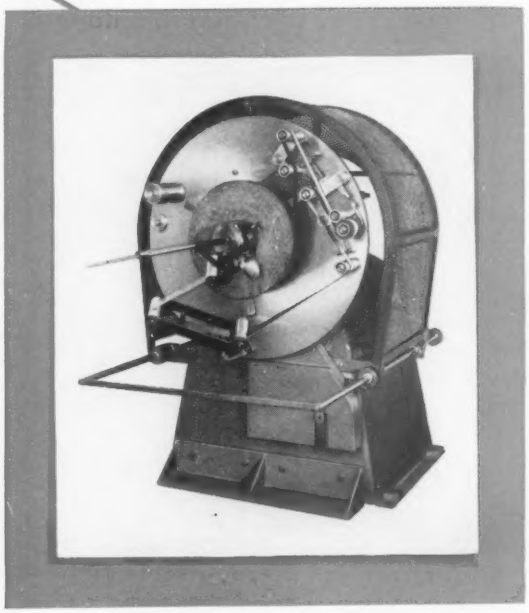
12-Wire Tube Strander



production

insulation

Eccentric Taping Head



Concentric Taping Head

New England Butt Co.

Division Wanskuck Company

304 Pearl Street · Providence 7, R. I.

In **ENGLAND** — James Day (Machinery) Ltd., 28 Maddox Street, London, W-1.

BRAIDERS
CABLERS
TAKE-UPS
BUNCHERS
STRANDERS
TAPING MACHINES

Need special-purpose wire or steel?

Whether it's manufacturing special wire and steel to your specifications, or working with your engineers to develop new types to solve new problems, you can always count on National-Standard for something extra . . . in quality control . . . in product uniformity . . . and in service! Not just an idle boast. We've been doing it that way for over 50 years . . . and would like very much to prove it to *you*.

Check these N-S products

NATIONAL-STANDARD DIVISION

Niles, Michigan
Phone: MUtual 3-8100

Tire Bead Wire
Stainless Steel Wire . . . . .002" to .125" Diameter
Music Spring Wire . . . . .015" to .125" Diameter
High Carbon Steel Wire . . .002" to .110" Diameter
Fine Wire Rope . . Minimum Rope Diameter .008"
Maximum Rope Diameter .080"
Braided Wire—Flat . . . . . Up to 1" Wide
Braided Wire—Tubular . . . . Up to 24" Diameter
Static Braids—Ferrous and Non Ferrous Copperply Wire Up to .250" Diameter
Nickelply (Electro nickel plated steel wire) . . . . Up to .340" Diameter
Electro Brass Plated Steel Wire Up to .340" Diameter

ATHENIA STEEL DIVISION

Clifton, New Jersey
Phone: Prescott 9-1881

High Carbon Spring and Specialty Steel Strip
Flat Wire Cold Rolled, Annealed, or Tempered—
Blue, Straw, Bright, or Commercial

Scaleless. Width: Maximum—Tempered . . . 6½"
Maximum—Annealed . . . 16"
Thickness: Maximum . . . . . .015"
Minimum . . . . . .065"
Other Specialties. Stainless: Cold Rolled Maximum . . . . . .001"
Maximum Width . . . . . .375"
Maximum Thickness . . . . .025"
Nilcor: Maximum Width . . . . . 1"
Maximum Thickness . . . . .025"

WORCESTER WIRE DIVISION

70 James Street
Worcester, Massachusetts
Phone: 2-2871

Fine Wire: Diameter .002" to .075"
Stainless
High Carbon
Low Carbon
Monel
Galvanized
Tinned
Cadmium Plated
Music Spring Wire: Diameter .002" to .250"
Copperply Wire: Diameter up to .250"
Flat Wire: Maximum .125" Wide
Maximum .060" Thick
Nickelply (Electro nickel plated steel wire): Up to .250"
Electro Brass plated steel wire: Up to .250"

REYNOLDS WIRE DIVISION

Dixon, Illinois
Phone: 3-1411

Wire Cloth
Carbon and Stainless Steel—Non-Ferrous—Copperply
Plain Weave . . . . Up to 300 Mesh } In suitable metals
Twill Weave . . . . Up to 300 Mesh }
Dutch Weave . . . . Up to 500 Mesh
Finishes: Electro and Hot-Dip Galvanized, Tinned, Lead Coated, and Varnished or Enameled

NATIONAL STANDARD

DIVISIONS: NATIONAL-STANDARD, Niles, Mich.; *tire wire, stainless, music spring and plated wires* • WORCESTER WIRE WORKS, Worcester, Mass.; *high and low carbon specialty wires*
WAGNER LITHO MACHINERY, Secaucus, N. J.; *metal decorating equipment* • ATHENIA STEEL, Clifton, N. J.; *flat, high carbon spring steels* • REYNOLDS WIRE, Dixon, Ill.; *industrial wire cloth*

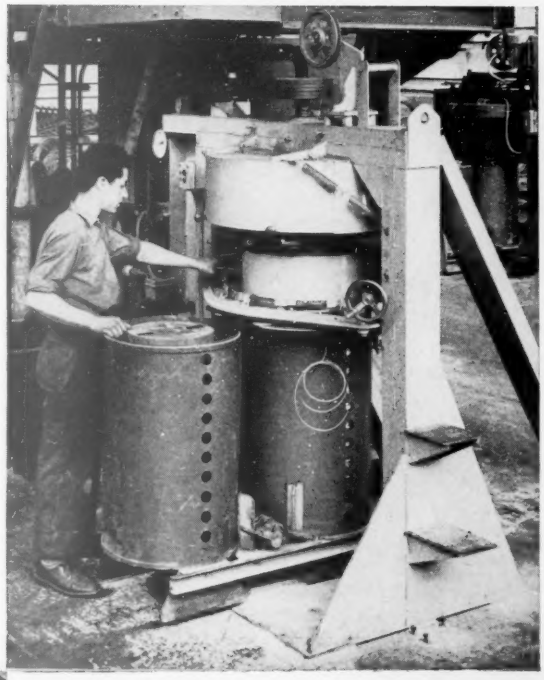
4.800

feet per minute

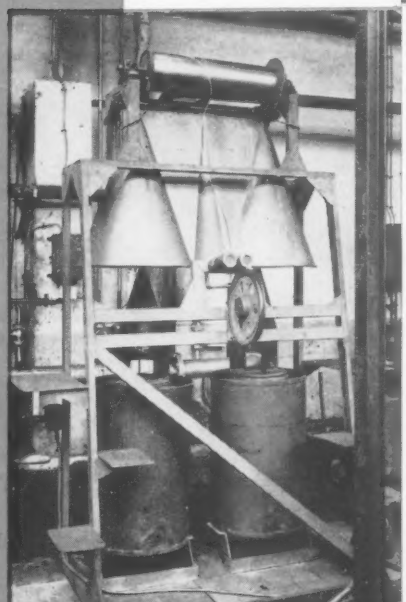
is the speed never reached before of the new continuous

Godderidge

Packaging Unit



Take-up device on a wire-drawing machine.



Double high-speed Pay-Off Stand

OUTSTANDING FEATURES :

- Range of diameter: from 8 to 24 B & S
- Changing of drums at full speed
- Diameter control possible whilst running
- Both-ends of wire accessible, therefore welding and continuous supply of high speed extruders possible by new double

PAY-OFF STAND

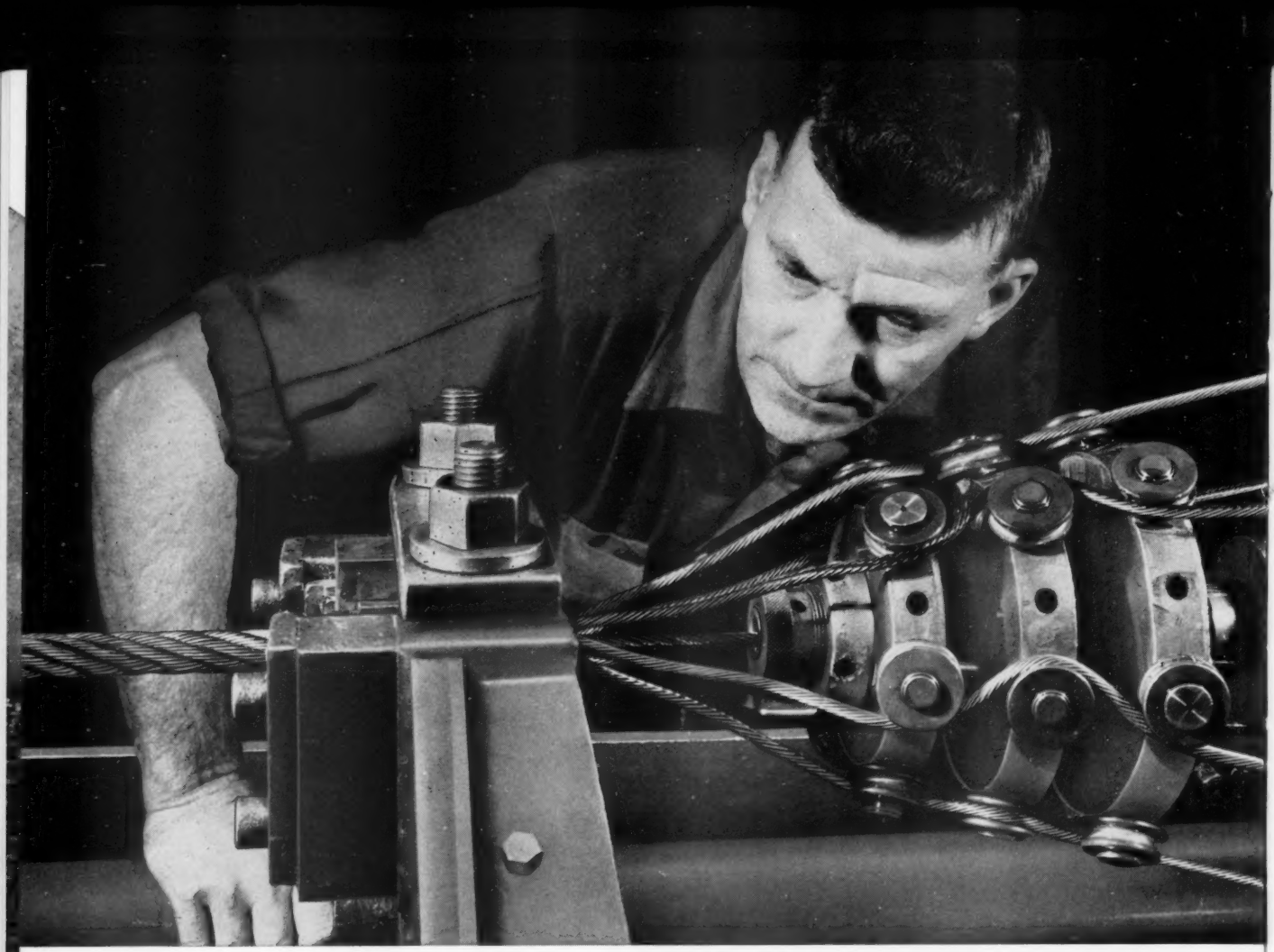
For further details write to

Godderidge

11, avenue Henri Barbusse HOUILLES (Seine-et-Oise)

FRANCE

JEAN MARQUENET



At the closing die on a wire rope closing machine, strands are pre-formed by rolls into the shape they will have in the finished rope. In the operation at right, strands are closed into finished rope.

Pittsburgh Steel Does A Job . . .

Where Wire Takes A Beating

Quality of Pittsburgh Wire in Rochester Ropes Protects Lives

Wire rope manufacturers just don't take chances on quality.

They can't afford to because their ropes have such vital jobs as protecting human lives and withstanding corrosive sea water for long periods.

The wire rope manufacturing process itself requires a wire of superior strength. Look at the photo above. Imagine the machine pictured is revolving at high speed as it preforms wire strands to a helical shape before the strands enter the closing die. In this process uniformity in the wire is essential to accurate preforming.

All requirements of rope makers for wire are exacting. You can be sure a wire mill which consistently meets those requirements is a good bet to produce other types of wire of high quality.

Go into the plant of one quality-conscious wire rope manufacturer—Rochester Ropes, Inc., of Culpeper, Va.—and you will see these requirements being met by wire from Pittsburgh Steel Co.

Even before manufacturing starts, Rochester Ropes, Inc., tests every coil of incoming wire to make sure the finished rope will give long service on tough jobs. Here's what the tests measure:

- **Torsion strength** which gives wire the ability to take repeated twisting action, both on the rope-making machines and in service.
- **Freedom from seams, inclusions and varying degrees of hardness** assures the wire rope user that no individual wires in the rope are likely to break under sudden or heavy strains.
- **Tensile strength** gives wire its work-horse qualities. The basic strength of wire rope comes from its tensile strength, the wire's ability to pick up a heavy load and to last for years in the field.
- **Zinc coatings** are tested to make sure the covering of protective metal is uniform and adequately thick. Wrapping tests make sure zinc won't flake off when a hawser scrapes against a wharf or that it won't peel when twisted around a stanchion.
- **Toughness** shows up better in the field than in the laboratory. Toughness is the quality which results from proper grain structure, from uniform dimensions which as-

Every coil of rope wire shown here before rewinding on bobbins for use on stranding machines is carefully tested. In the background are stranding and closing machines in the Rochester Ropes' plant.

sure even wear on the rope and from the skill with which wires are twisted into strands and strands into finished rope.

Finished wire rope undergoes another series of tests which make certain every coil of rope leaving the Rochester plant will do the specific job for which it was built.

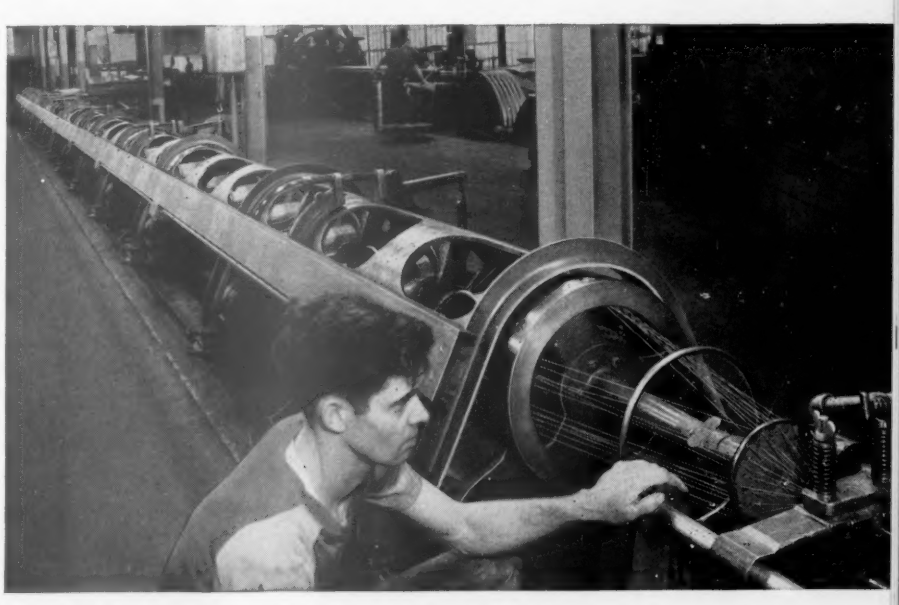
Pittsburgh Steel's rope wire, by making good in Rochester Ropes' laboratories, production machines and in the field, proves to all kinds of wire users that Pittsburgh Wire can be depended on for high, uniform quality.

"The quality of our wire rope starts with the wire we buy," said William L. Rochester, Jr., vice president in charge of sales at Rochester Ropes. "The quantity of rope wire we buy from Pittsburgh Steel speaks for the regard we have for its wire."

Whether you use oil tempered spring wire, aircraft wire, brush wire or any other kind of manufacturers' wire, you can enjoy the advantages that are built into rope wire.

Pittsburgh Steel wire will help you make a better product, lower operating costs and provide greater customer satisfaction.

Investigate these opportunities today. A telephone call to any of the district offices listed at right will bring skilled engineering help to you immediately.



Forty-one bobbins pay off wire on this 120-foot long stranding machine in the Culpeper, Va. plant of Rochester Ropes, Inc.

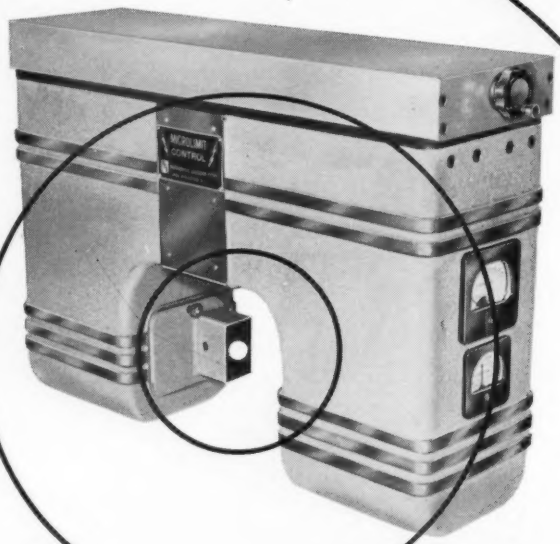
Pittsburgh Steel Company

Grant Building • Pittsburgh 30, Pa.

District Sales Offices

Atlanta	Cleveland	Dayton	Los Angeles	Pittsburgh
Chicago	Dallas	Detroit	New York	Tulsa
		Houston	Philadelphia	Warren, Ohio

AUTOMATION STARTS HERE!



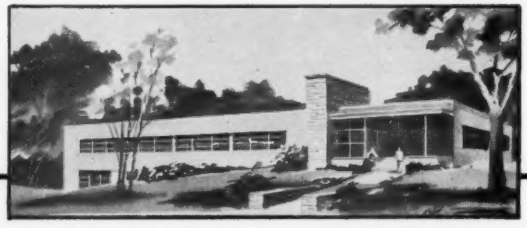
MICROLIMIT CONTROL CABLE GAUGE accurately controls DIAMETER of

THERMOPLASTIC INSULATED CABLE
C. V. PRODUCED RUBBER CABLE
EXTRUDED TUBES, SHAPES

Continuous, non-contact measurement and control of diameter *at the extruder* makes possible

- minimum starting scrap
- lower labor costs
- reduced compound costs

For further information—



INDUSTRIAL GAUGES CORPORATION • WEST ENGLEWOOD, NEW JERSEY

You'll get a better product with

Pittsburgh PX-120 DIDP

Pittsburgh PX-120 (DiIso Decyl Phthalate) offers you a unique combination of properties which make it especially suitable for the economical production of vinyl-jacketed electrical wiring.

PX-120 possesses excellent low-volatility, a prime consideration in vinyl wire insulation, especially where higher-than-normal temperatures are encountered. For additional retention of elongation on aging, Pittsburgh PX-120 can be supplied with Bisphenol A added.

Whatever your vinyl product, you can count on PX-120 for good permanence, resistance to extraction, and low temperature properties . . . plus a low specific gravity that enables you to enjoy appreciable economies on a pound-volume production basis.

May we acquaint you further with this versatile plasticizer? Write for samples and technical data.

PITTSBURGH *Job-Rated* PLASTICIZERS

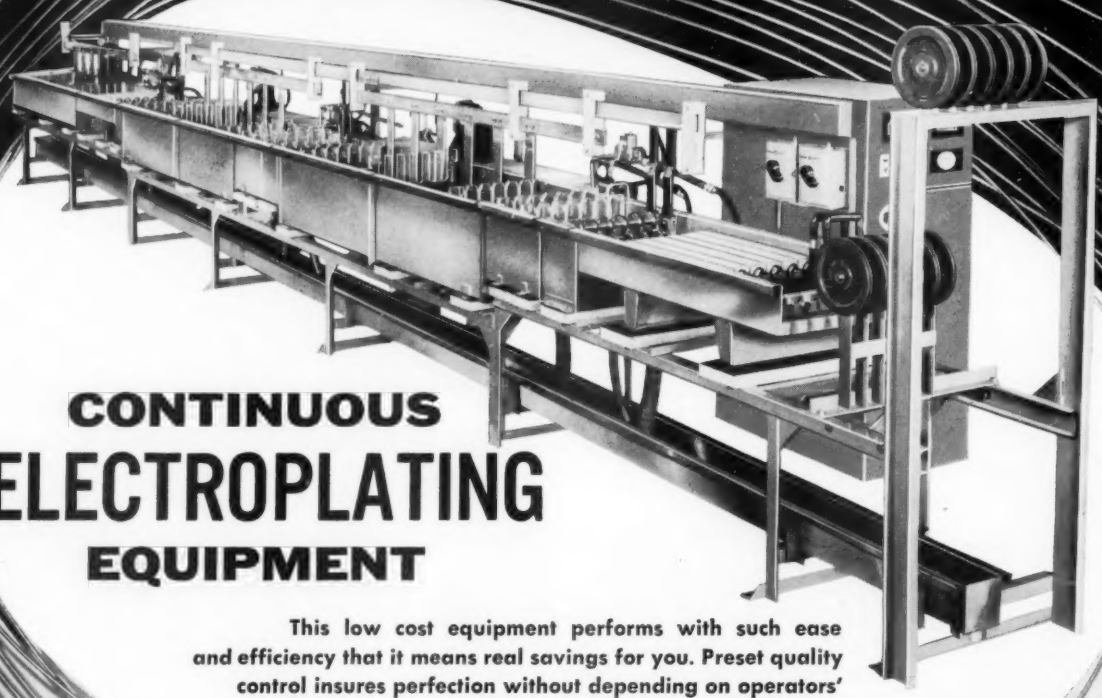
PX-104 DiButyl Phthalate
PX-108 DiIsoOctyl Phthalate
PX-114 Decyl Butyl Phthalate
PX-118 IsoOctyl Decyl Phthalate
PX-120 DiIso Decyl Phthalate
PX-138 DiOctyl Phthalate
PX-313 Modified Alkyl Phthalate
PX-208 DiIsoOctyl Adipate
PX-218 IsoOctyl Decyl Adipate
PX-220 DiIso Decyl Adipate
PX-238 DiOctyl Adipate
PX-404 DiButyl Sebacate
PX-438 DiOctyl Sebacate
PX-800 Epoxy
PX-917 TriCresyl Phosphate

WSW 5990A

COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

LOW COST **precision wire plating**

UNIFORM COATINGS MAINTAINED AT HIGH SPEEDS



CONTINUOUS

ELECTROPLATING

EQUIPMENT

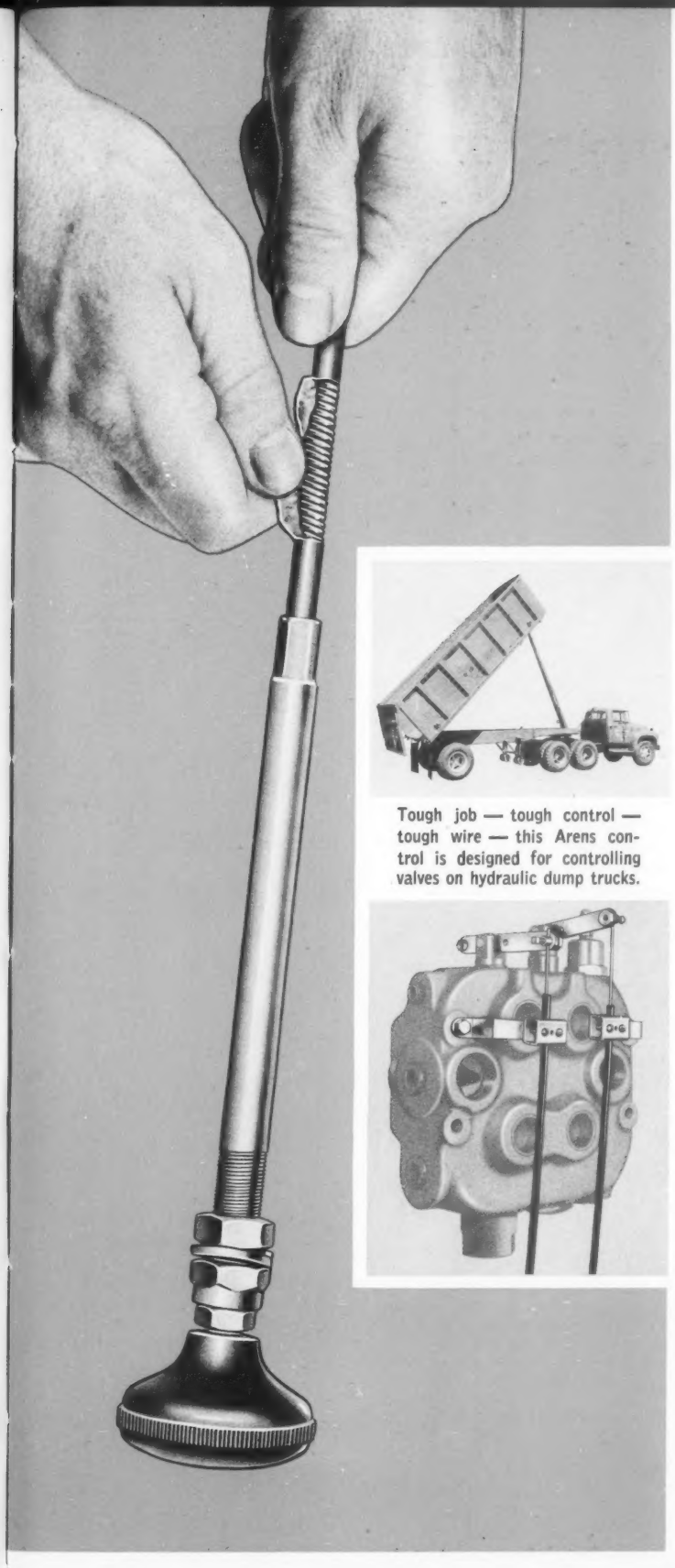
This low cost equipment performs with such ease and efficiency that it means real savings for you. Preset quality control insures perfection without depending on operators' skill. No toxic fumes, clean operation at low temperature, elimination of work hardening during processing, and many other features are the result of experience and sound engineering that go into the design of all Universal equipment.

We furnish complete installation . . .
For further information write to:

UNIVERSAL INDUSTRIAL EQUIPMENT CO.

SECAUCUS, NEW JERSEY

SOLE AGENT IN CANADA: E. V. LARSON CO., LTD., TORONTO, CANADA



Tough job — tough control — tough wire — this Arens control is designed for controlling valves on hydraulic dump trucks.

KEYSTONE GALVANIZED MB SPRING WIRE STUDY

Uniform wire is the secret at ARENS CONTROLS, INC.

EVANSTON, ILLINOIS

ARENS CONTROLS INC.

Arens manufactures a wide selection of quality controls used on many applications ranging from jet bombers to lawn mowers. Because of their range of sizes and types, they have streamlined their control production assembly to the point that a completed control can come off the line every few seconds. Naturally, failure anywhere along the line means costly slow-up of production. That's why they specify Keystone Galvanized MB Spring Wire for their most critical operation—manufacture of the control casing.

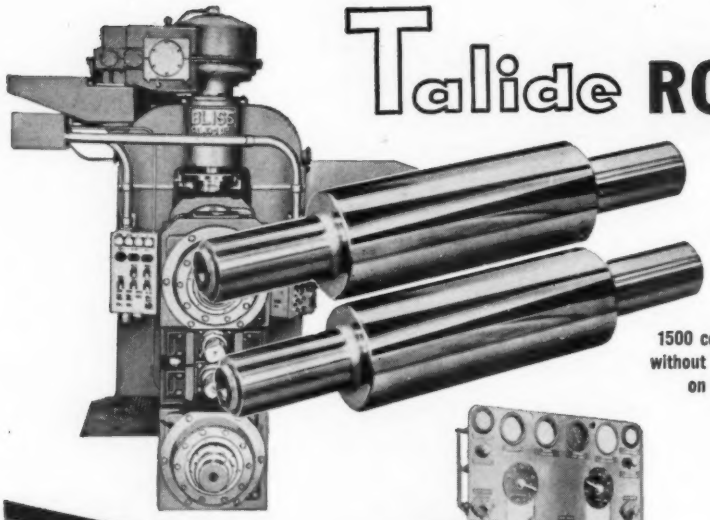
Keystone Galvanized MB Spring Wire has consistent uniformity of composition, temper and diameter. It is manufactured by Keystone's unique method of cold drawing after galvanizing to produce a dense, smooth zinc coating free from flaking.

Keystone Wire can help you, too, assure yourself of steady production. We invite you to talk it over with your Keystone representative or call us . . . today!

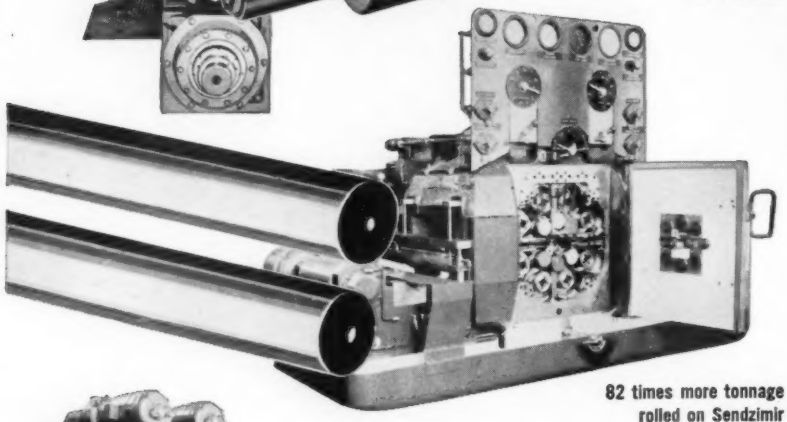
Keystone Steel & Wire Company
Peoria 7, Illinois

KEYSTONE
WIRE FOR INDUSTRY

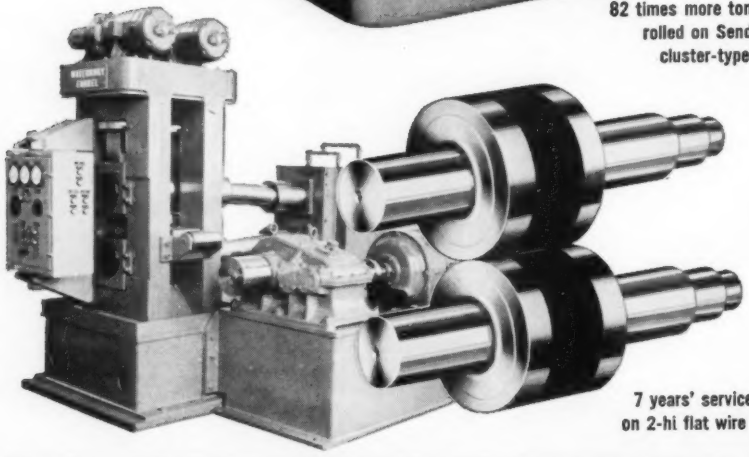
Talide ROLLS OUTLAST ALL OTHERS!



1500 coils rolled without a regrind on 4-hi mill.



82 times more tonnage rolled on Sendzimir cluster-type mill.



7 years' service life on 2-hi flat wire mill.

Talide rolls have proven far superior to both steel rolls and carbide rolls of any other make.

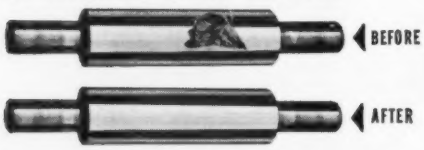
During the last five years Talide rolls have been adopted by every major strip steel producer. Metal Carbides pioneered and developed tungsten carbide rolls and successfully adapted them to all types of rolling mills including STECKEL, BLISS, UNITED, MESTA, STANAT, SENDZIMIR, WATERBURY-FARREL, TORRINGTON, RUESCH, FENN, WEAN, COLD METAL, etc.

Talide work rolls are ultra-hard, extremely dense and porous-free. Manufactured from highest purity tungsten carbide powders, the surface finish of a Talide roll is smoother than one microinch. Hard as a diamond, it will take a "bigger bite" than a steel roll. Strip steel of all analyses can be rolled down to thinner gauge, with more accuracy, greater reductions and with fewer anneals than possible with any other roll.

ONLY TALIDE WORK ROLLS GUARANTEE THESE ADVANTAGES

- ★ MORE PRODUCTION
- ★ BETTER FINISH
- ★ LONGER LIFE
- ★ HIGHER SPEEDS
- ★ CLOSER TOLERANCE
- ★ IMPROVED PHYSICALS
- ★ GREATER REDUCTION
- ★ LESS DOWN TIME
- ★ FEWER REJECTS
- ★ LESS MAINTENANCE

EXCLUSIVE REPAIR SERVICE



Broken or damaged carbide rolls can be re-worked to first class condition with all defects eliminated at one-half original cost. Only Metal Carbides offers this service—because of its exclusive hot press method.

Talide Rolls are made in lengths up to 100", diameters up to 25", and up to 5000 lbs. by weight.

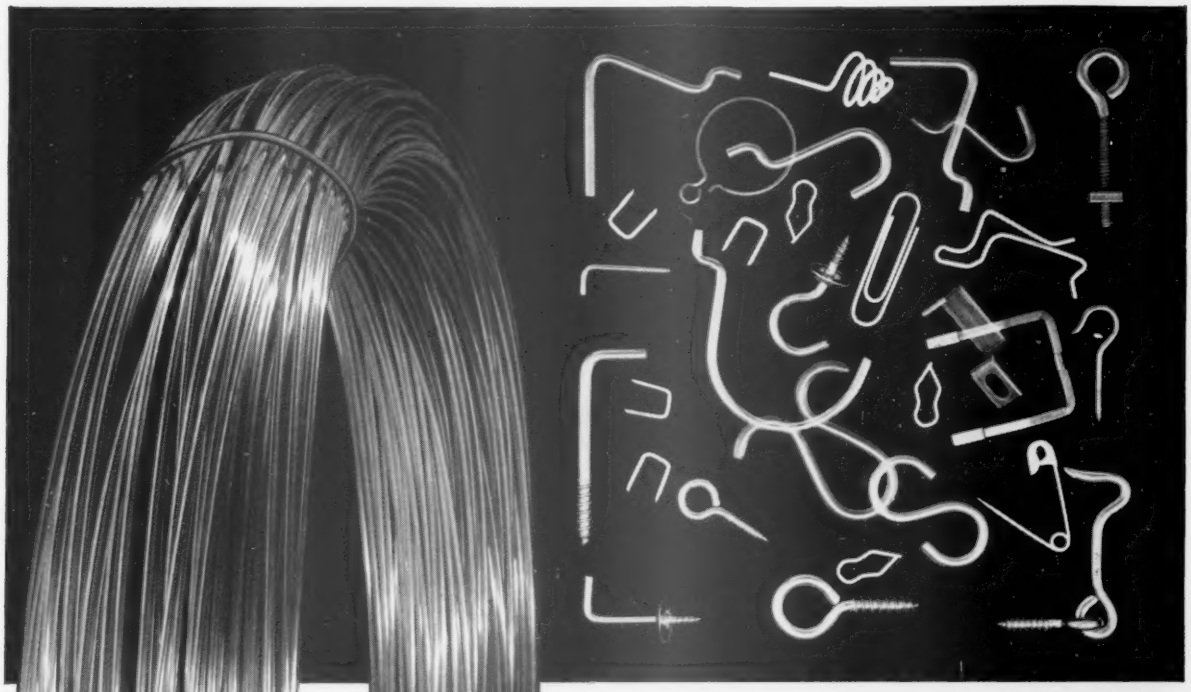
Metal Carbides Corporation,
Youngstown 12, Ohio.

Send for new 76-page catalog 56-G

SUPERSET GRINDING WHEEL

The Superset diamond grinding wheel was specially developed for grinding carbide rolls to highest possible surface finish and luster. Made of 4-8 micron size diamond dust, it imparts a surface finish far superior to any other commercial wheel. Available in sizes up to 25" diameter

METAL CARBIDES CORPORATION
MC
TALIDE®
YOUNGSTOWN 12, OHIO
HOT PRESSED AND SINTERED CARBIDES • VACUUM METALS
HEAVY METAL • ALUMINUM OXIDE • HI-TEMP. ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY



FABRICATE PARTS

easier, faster, better with

UNITED WIRE

When specs are tough, requirements rigid, savings essential, fabricate your parts with United Wire . . . aluminum, brass and copper alloys including 10-12-18% nickel silver. Here are the big important things you'll find in United Wire:

- Commercially bright — reduces finishing cost after forming.
- Tolerances — drawn or shaped to your most exacting standards.
- Temper — uniform throughout, every order, every time.
- Uniform coils — for trouble free pay-off.
- Size and shape — available in most sizes and shapes — round, square, flat and half-round.

Your "Wire Forms" can be fabricated easier and better at high speed production with low or no scrap loss by using "United" round or shaped wire.

Permanently United

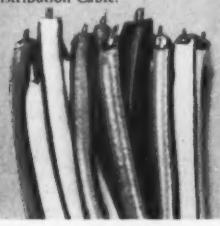
UNITED WIRE
AND SUPPLY CORPORATION

PROVIDENCE 7, RHODE ISLAND

ALUMINUM, BRASS, COPPER WIRE AND TUBE - BRAZING ALLOYS AND FLUXES

THE MESSAGE IS: MONSANTO

Sturdy OPALON 72285 over primary insulation for color-coded, weather-resistant jacketing. Polyethylene 14202 and 11302 for primary insulation of conductors and insulation for steel support wire in Multi-Pair Distribution Cable.

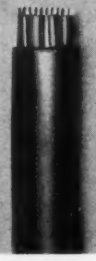


OPALON 1706 for semi-rigid primary insulation in various types of communication cable.

Polyethylene 12203 and 12253 for primary insulation, Polyethylene 14202 for jacketing in jacketed Thermoplastic-insulated, Thermoplastic-sheathed Telephone Cables.

Rugged weather-resistant color-coded OPALON 72285, available in eight standard colors, for primary insulation and Polyethylene insulation for steel support wire on Urban Distribution Cable.

OPALON 1006 for primary insulation, OPALON 72217 for jacketing in Inside Telephone Wiring Cable.



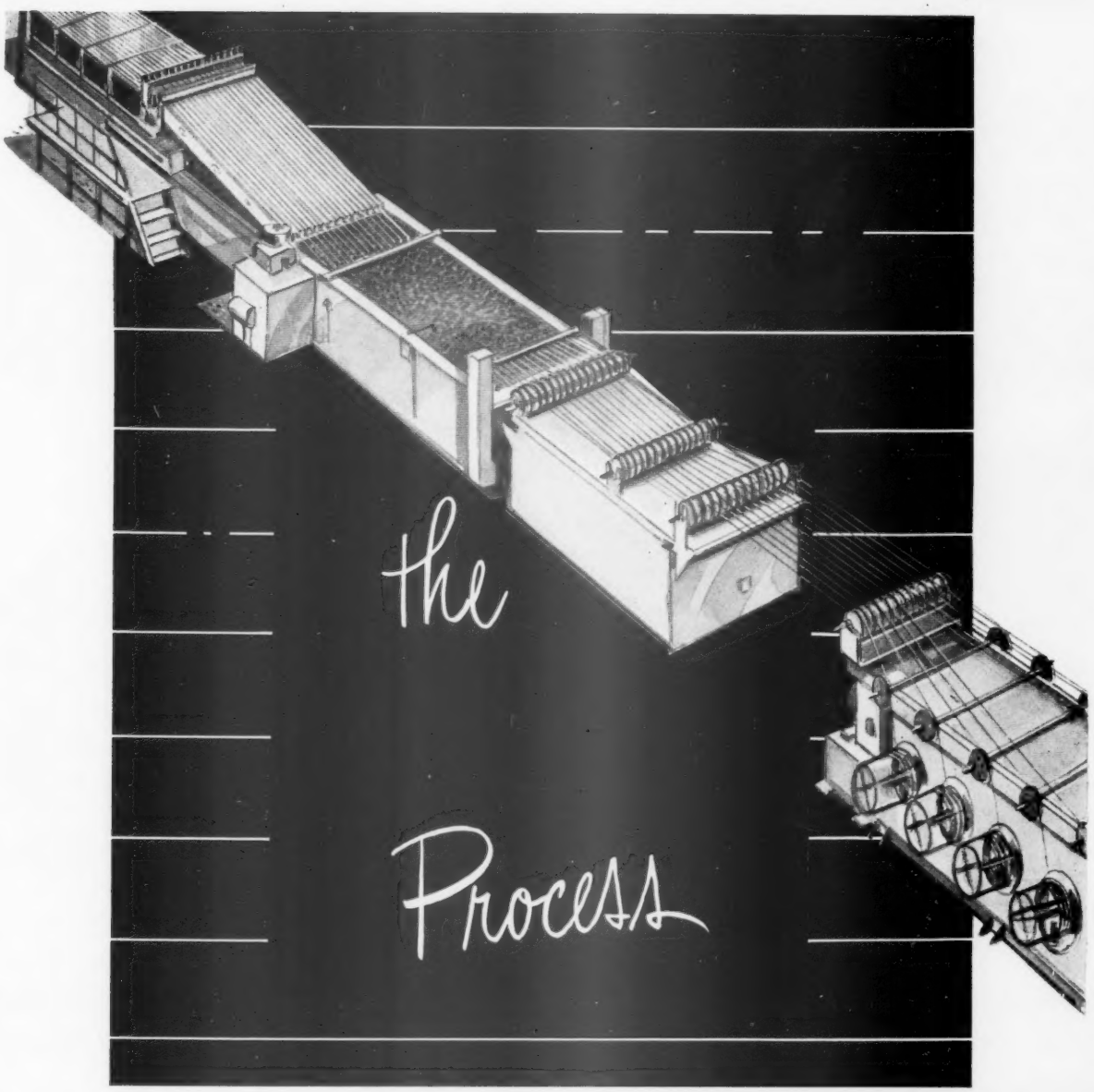
your finest single-source for **polyethylene and vinyl** *telephone insulating compounds*

Wire and cable producers like the multiple choice that Monsanto supply offers—9 formulations, polyethylene or Opalon vinyl, all specially developed for critical communications applications.

Here, from one great single-source, are the insulating compounds combining the many different mechanical and electrical properties you need . . . insulating efficiency, extrusion characteristics, surface finish, weatherability, colorability.

Call in your local Monsanto representative for the full communications story, or write for technical data and other information to Monsanto Chemical Company, Plastics Division, Room 2011, Springfield 2, Massachusetts. OPALON: REG. U. S. PAT. OFF.

MONSANTO



● The TRAUWOOD PROCESS is a new patented principle of wire heating, applied to the continuous strand patenting, oil tempering, and annealing of round and flat carbon and alloy steel wire and strip. Progressive manufacturers demand the most efficient, scientific, and up to date heat treating equipment available. Today's applications for wire and strip require the use of material having the highest possible physical and fatigue properties. Many manufacturers are installing Trauwood equipment to replace equipment of ordinary design. For superior quality, greater production, and economy of operation, you cannot specify a better heat treating practice than that which the TRAUWOOD PROCESS affords.

Send us your inquiries and for illustrated brochure

TRAUWOOD WIRE AND STRIP HEAT TREATING EQUIPMENT IS ENGINEERED AND BUILT TO YOUR SPECIFIC REQUIREMENTS

THE TRAUWOOD ENGINEERING COMPANY

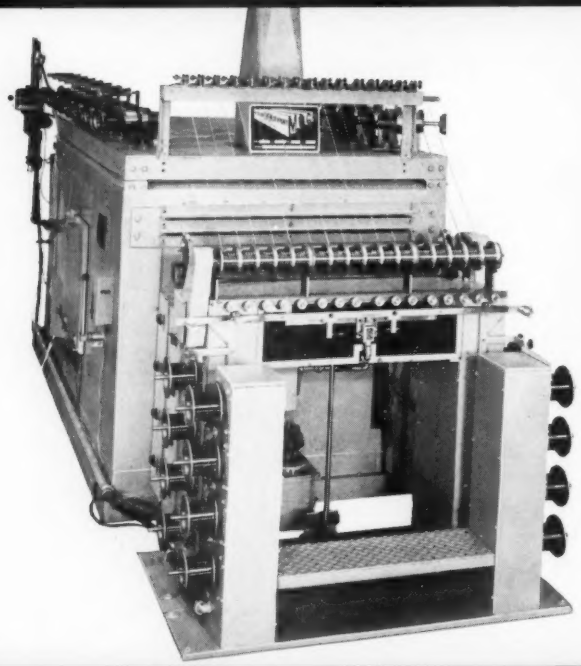
P. O. BOX 2719, WEST PARK STATION • 15320 BROOKPARK ROAD

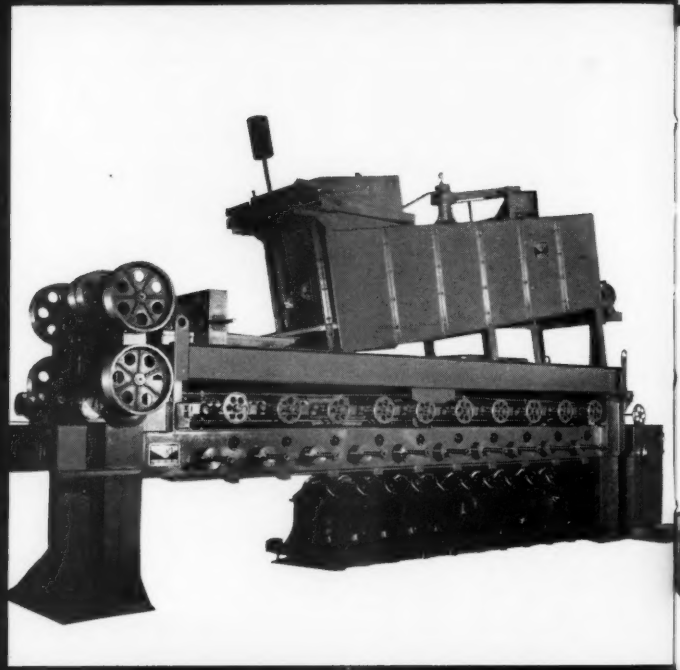
CLEVELAND 11, OHIO

Representatives in principal cities and foreign countries on request

EXPERIENCE:

Twelve years of development in gas-fired equipment — Three years of "on-the-job" production results





WIRE ENAMELING MACHINES

Typical of the complete line is this type "B" machine which handles wire from 31 A.W.G. to 42 A.W.G.

Five other models complete the range from the finest through large rectangles. The horizontal, high volumetric, recirculating double-pass oven allows greatly increased production by rapid heat impartation and a high degree of temperature uniformity throughout the wire chamber. Other features include: a catalyst within the recirculating stream consumes solvents and releases heat energy, individual clutches in each head of the wire capstan, automatic braking device controlling wire tension.

CONTINUOUS BRIGHT ANNEALERS

This is the first direct gas-fired annealer using the heating equipment as an internal inert atmosphere generator. Advanced mixing and burning equipments are utilized which exclude the need for external sources of steam or costly inert atmospheres. They are available in horizontal or vertical mounting positions. MOCO Annealers are of the high volumetric recirculating type with automatic air-fuel gas ration maintained over the entire range. They have a water sealed exit. No external source of inert atmosphere is needed.

WIRE ENAMELING DIVISION

MICHIGAN OVEN COMPANY

425 Brainard • Detroit 1, Michigan

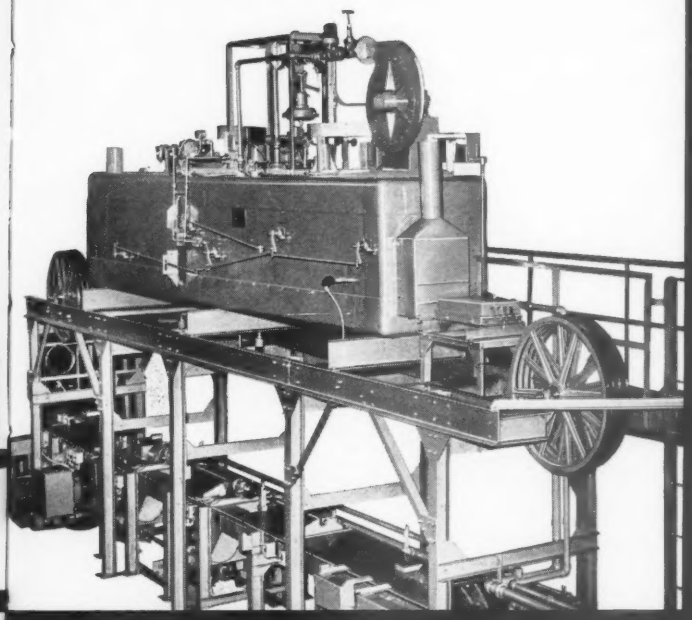
Proof that experience is your guarantee of maximum production at a savings in wire enameling equipment

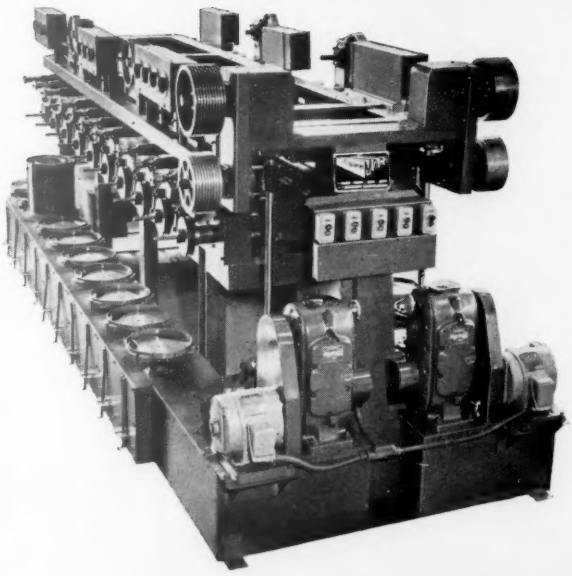
Over twelve years ago, MOCO began its engineering experiments in the development of high volume recirculating wire enameling machines and complimentary equipment – both gas fired and electrically heated.

Using principles highly successful in other fields of heat processing, MOCO aimed for – and attained – a line of wire machinery far superior to equipment presently on the market.

After complete testing in company-owned installations, the first ovens were installed by some of the leading wire manufacturers over three years ago. Reports have been unanimous. MOCO-engineered wire equipment – utilizing modern recirculating oven features combined with the latest wire handling and coating machinery – have changed the standards of the industry.

Here are just a few of the advanced features made possible by MOCO wire equipment:





GLASS INSULATING MACHINES

This MOCO machine is capable of applying two servings of glass or yarn and four coats of baked insulating varnish simultaneously. It turns out large quantities of heavy rounds and rectangulars (up to 150 M. Sq. Cross Sectional Area). MOCO's revolutionary Rapid-Cool Oven lets you stop production without damage to wire in the oven. Return to full production in a matter of seconds because of the rapid rise of the temperature inside the oven.

REEL-R-DRUM PACKERS

This is the first machine to allow you to take-up on either a spool or pail pack. It has a speed range from 20 to 120 feet per minute. You can produce two wire sizes simultaneously through the same process at different speeds. Handling wire sizes ranging from .008″ to .025″ in diameter, this MOCO Reel-R-Drum packages annealed copper magnet wire on different reels or in nominal 100 lb. capacity Payoffpak Drums, or both, simultaneously.

ANOTHER ENGINEERING ACHIEVEMENT BY

MOCO

For More Details on these Proven Features and Many Others Fill in this Handy Coupon

Please send me complete information on the many outstanding MOCO features:

☐ Wire Enameling Machines ☐ Annealers

☐ Glass Insulating Ovens ☐ Reel-R-Drum Packers

NAME_____ TITLE_____

COMPANY_____ ADDRESS_____

CITY_____ ZONE_____ STATE_____

THE FEDERAL MANUFACTURING CO. WALLINGFORD, CONN.

WIRE MACHINERY • TESTING EQUIPMENT

Shown at Left

FEDERAL CV SPARKER

Model CV 15 (15,000 Volts)

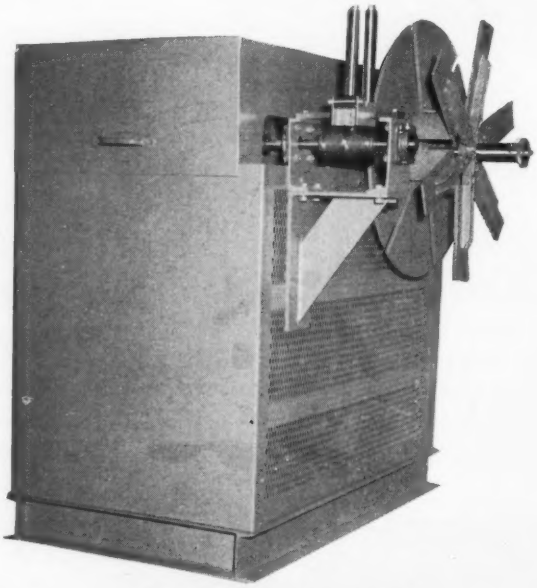
Model CV 30 (30,000 Volts)

For continuous operation on Extruders and Twisters. Supplied with or without stand. Length and size of electrode is optional.

Shown Below

COLLAPSIBLE COILER by FEDERAL

Variable or Constant Speed with Electric Brake. Supplied in sizes to meet your requirements. Traverse driven from Coiler shaft.



OTHER FEDERAL PRODUCTS

PAYOFFS • TAKEUPS • CAPSTANS
RE-SPOOLERS • MEASURING MACHINES
PATCHING MOULDS • COILING MACHINES
PAYOFFPAKS

TESTING EQUIPMENT — AC & DC

FOR INSULATED WIRE	FOR ENAMELED WIRE
★ Dielectric	★ Dielectric
★ High Potential	★ Abrasion Scrape
★ Continuity	★ Continuity

Write or telephone for full information on any equipment in which you are interested.

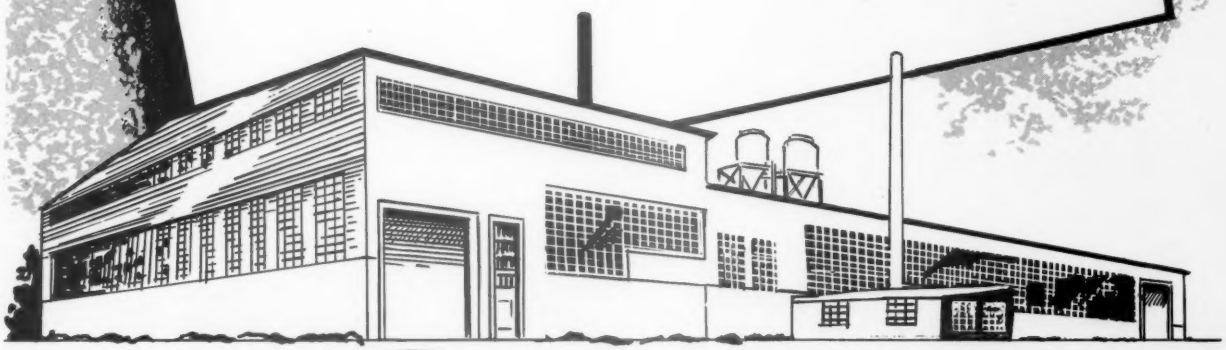
CARRIS REELS

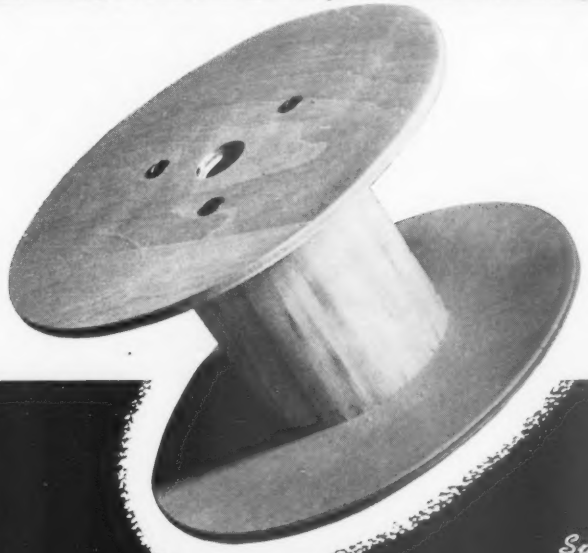
INCORPORATED

announces a

NEW LOCATION IN RUTLAND, VERMONT

Phone: PRospect 3-7388





We're now making our own plywood, too! Due to the ever-increasing demand for our spools and reels, we've had to make our second move in just two years! And in our new and spacious quarters we are manufacturing plywood. Since it's made especially for spools and reels, even better-grade products will result—CARRIS spools and reels, now QUALITY-CONTROLLED from plywood to finished spools and reels!

CARRIS REELS
INCORPORATED
RUTLAND, VERMONT
Specialists in the design and manufacture of
PLYWOOD REELS AND SPOOLS

Polyethylene insulation, vinyl jacketing

...for all cable in this chemical plant's 13.8 KV system

Cable for this installation supplied by:
Anaconda Wire & Cable Co.,
New York 4, N. Y.
Rome Cable Corp.,
Rome, N. Y.

Pulling and cutting cable. Combination of tough vinyl jacket and lightweight polyethylene insulation makes for easier handling by installation crews.

Splicing 13.8 KV cable insulated with BAKELITE Brand Polyethylene and jacketed with BAKELITE Brand Vinyl Plastic.

CRITICAL chemical processes carried out at the Union Carbide Chemicals Company plant at Torrance, California, need a dependable, uninterrupted flow of power at 13,800 volts.

To meet these demands, all the distribution cable installed there is insulated 100 per cent with BAKELITE Brand Polyethylene, jacketed with BAKELITE Brand Vinyl Plastic.

Most of the cable is underground. The hazards of moisture, electrolysis, chemical spillage, and heat are always possible. This insulation and jacketing combination withstands them all.

BAKELITE Polyethylene insulation has practically zero moisture absorption, and is inert to most chemicals. Its superior electrical properties include a low dielectric constant and high insulation resistance. BAKELITE Vinyl Plastic jacketing is extremely tough—withstands abrasion, is unaffected by most chemicals and oils, has excellent resistance to aging. Both materials are easy to strip and splice, and have good flexibility.

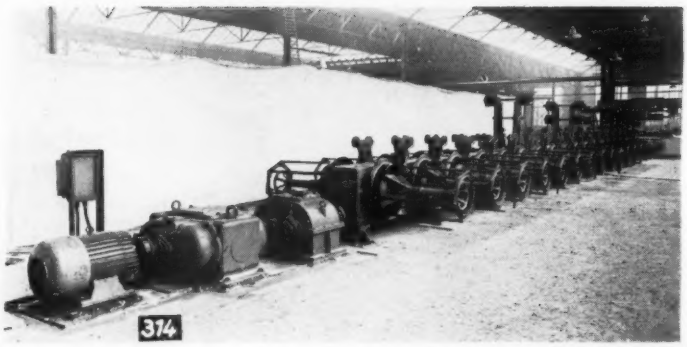
These performance benefits are typical of those that manufacturers of wire and cable covered with these materials can offer customers. Latest developments in the use of BAKELITE Polyethylene and Vinyl Plastics as jacketing and insulation are covered in *Kabelitems*, published periodically. To have your name placed on the mailing list, write Dept. ZX-196.

BAKELITE
BRAND
PLASTICS

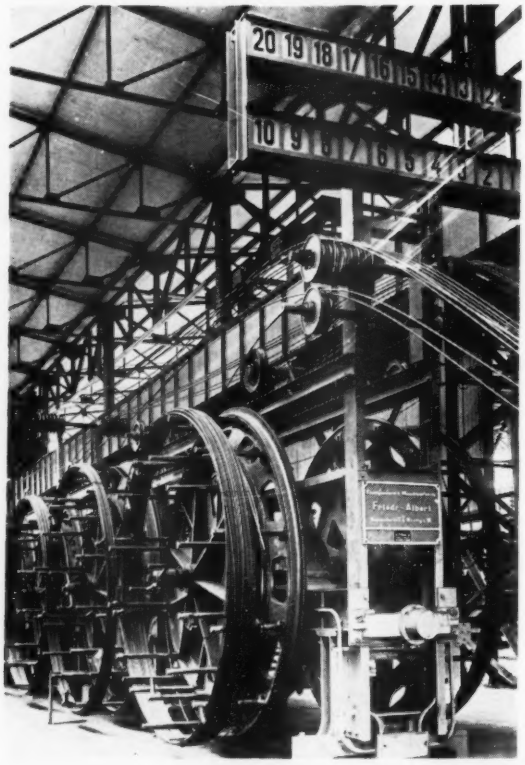
UNION CARBIDE

BAKELITE COMPANY, *Division of Union Carbide Corporation,* 30 East 42nd Street, New York 17, N. Y.

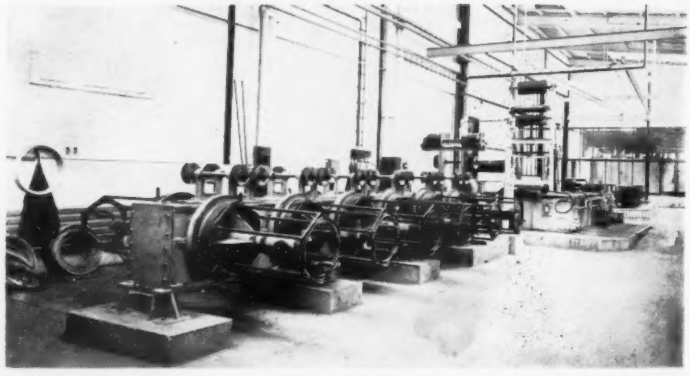
The terms BAKELITE and UNION CARBIDE are registered trade-marks of UCC



TAKE-UP FRAMES



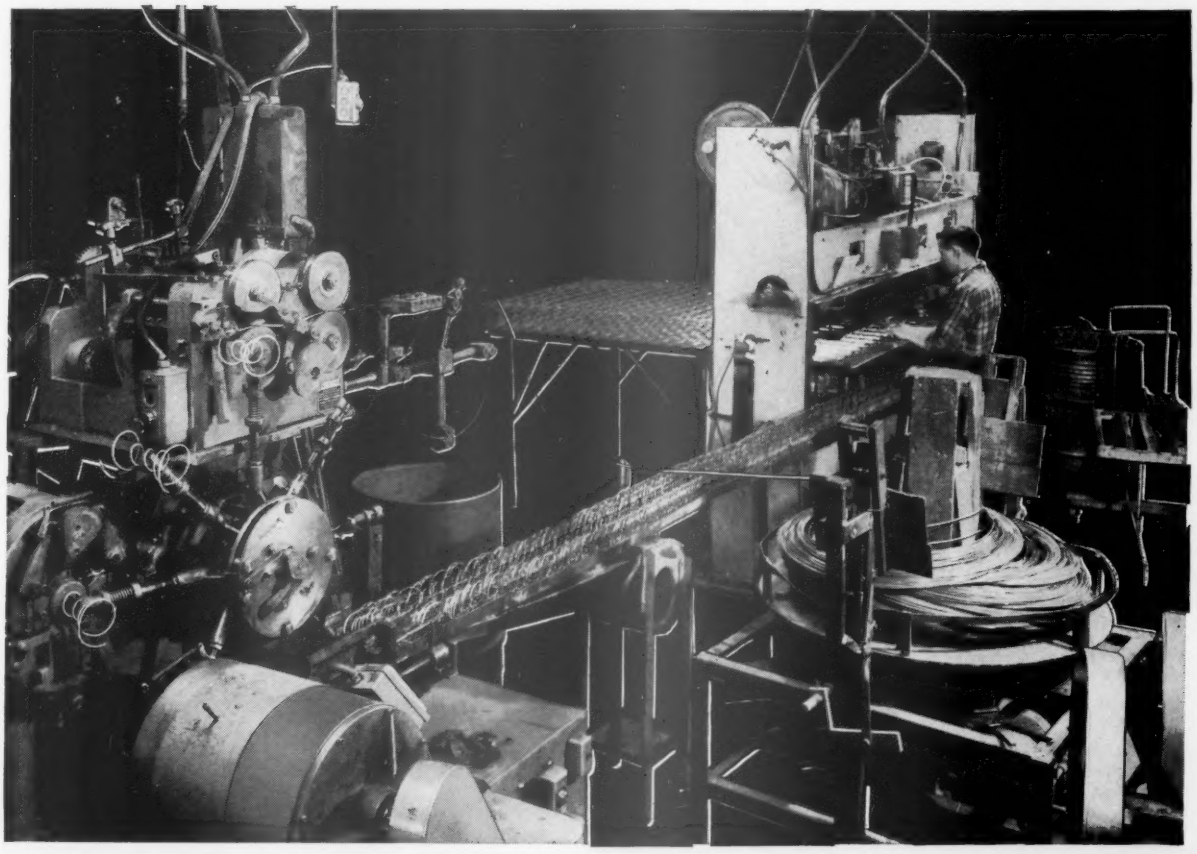
Take-Up Frames with stationary or rotating blocks, convertible for patenting or galvanizing installations.



FRIEDR. ALBERT, BREDENBRUCH (Westf.) Western Germany

Exclusive Representative: **PAUL REICHER — Machinery and Equipment**
P.O. Box 127, Willowdale, Ontario, Canada.

Double cone springs are produced automatically on this Wunderlich special high speed automatic coiling and knotting machine at the Sealy Mattress Company, Cleveland, Ohio. Machine coils, crimps, knots and heat treats springs made from 13½ gage Mastercraft spring wire, supplied in 600 lb. bundles.



UNIFORMITY OF J&L WIRE

speeds spring production

J&L spring wire reduces number of rejects, increases production, in modern automatic operations. One reason is that every bundle of spring wire is produced to closely controlled tolerances.

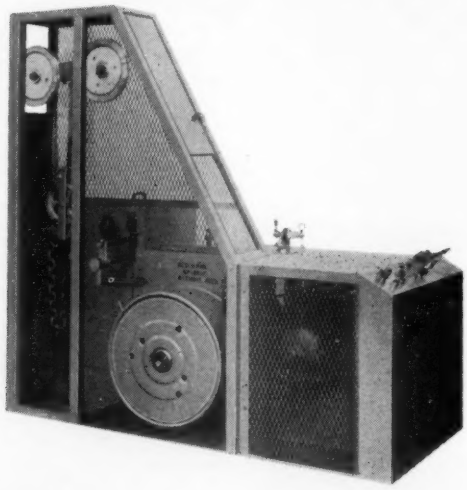
Rigid quality control assures uniform physical and dimensional characteristics. Every coil of famous Mastercraft, hard-drawn MB or Electromatic oil-tempered MB spring wire is thoroughly tested.

Try this superior Jones & Laughlin spring wire. You'll find it's tops in quality, competitive in price.

Call your J&L representative or write to the Jones & Laughlin Steel Corporation, Dept. 448, 3 Gateway Center, Pittsburgh 30, Pennsylvania.

Jones & Laughlin STEEL ... a great name in steel

AVAILABLE FOR IMMEDIATE DELIVERY



COOK

ROD BREAKDOWN MILL FOR COPPER OR ALUMINUM ROD

COMPLETE WITH: **Model D-13 Heavy Duty Rod Breakdown Machine**
Model S-1000 (1,000 pound) Spooler
150 HP Motor and Controls

MODEL D-13 SPECIFICATIONS	
Maximum Size of Entering Rod	5/16" Copper 3/8" Aluminum
Finished Wire Size	#8 to #16 B&S Gauge
Maximum Operating Speed	5,000 ft./minute
Maximum Number of Dies	13
Number of Drawing Blocks	6
Maximum Size of Die Case	1 1/2" dia. x 1" thick

MODEL S-1000 SPECIFICATIONS	
Spool Flange Diameter	30 inches
Traverse Width	11 inches
Barrel Diameter	16 inches
Spool Width O.A.	13 inches
Bore Size	5 inches
Maximum Spool Capacity	1,000 pounds
Motor Size	10 H.P.

Here, in this one complete unit, is all the equipment you need for reducing 5/16" copper rods (or 3/8" aluminum) to B&S sizes #8 through #16 wire at speeds up to 5,000 feet a minute. Dual oil system for lubricating main shaft bearing and the mechanical drive means minimum maintenance for this heavy duty machine. Built in transmission lets you select finishing speed.

And now, this Cook Rod Breakdown Mill is available for immediate delivery on **purchase** or **lease.** Get the complete details today. . . .

WRITE — WIRE — PHONE

COOK

MANUFACTURING CO.

50 EAST 25th STREET, PATERSON, N. J. • ARMORY 4-6380

•

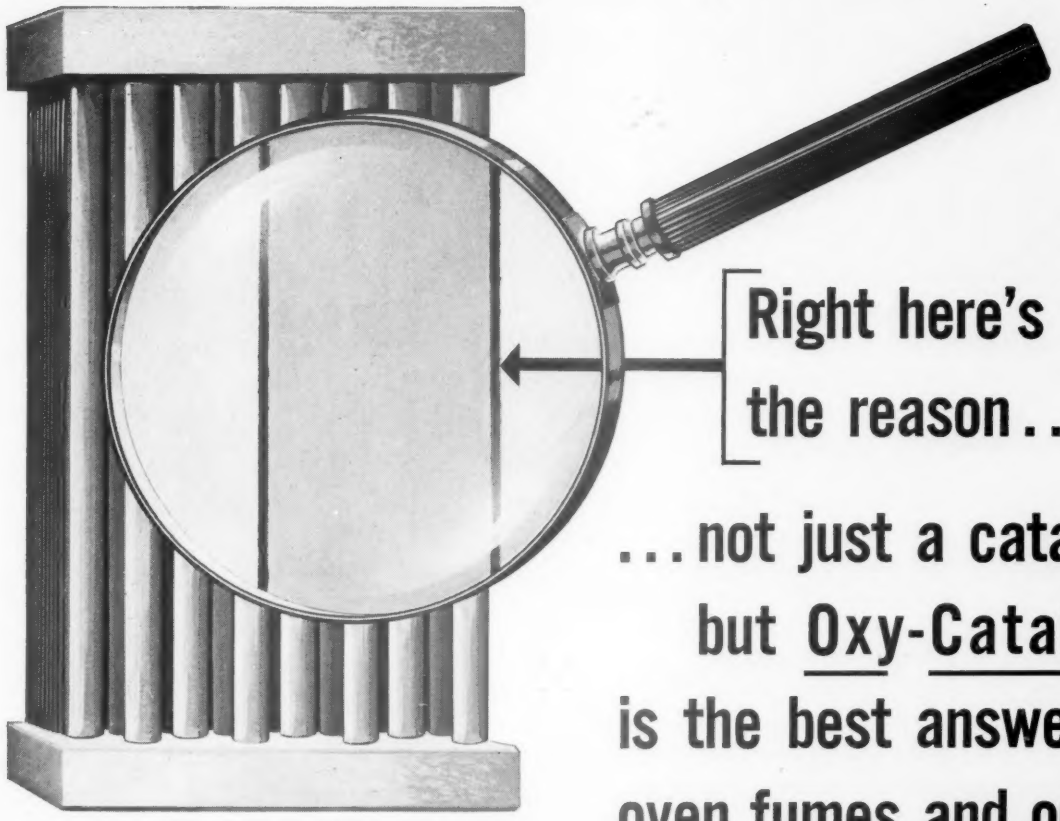
CANADIAN AGENT

E. V. LARSON CO., LTD., TORONTO, CANADA

•

EUROPEAN AGENT

CAPAMADJIAN LE MONNIER CIE LTD., PARIS, FRANCE



Enlarged cross-section drawing of an individual rod in an Oxycat unit

Right here's the reason...

...not just a catalyst but Oxy-Catalyst is the best answer to oven fumes and odors

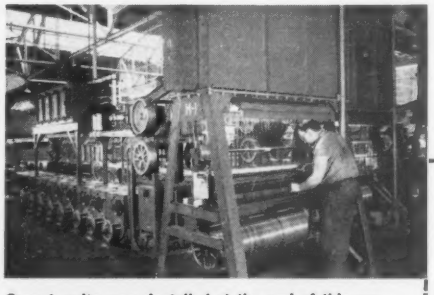
The secret lies in the .003-in. film on the porcelain Oxycat carriers. It's this more efficient catalyst which Oxy-Catalyst uses, a patented combination of alumina and platinum on porcelain, that gives better cleanup, better heat recovery, and longer catalyst life.

Oxycats can eliminate fumes and odors from drying ovens and other processes by oxidizing organic and combustible contaminants in the exhaust far more efficiently than any other catalyst ever developed.

To stop your oven fumes and odors—to recover waste heat—to reduce fire hazards and maintenance problems caused by troublesome condensates, Oxy-Catalyst offers a complete engineering service. We make the entire installation—engineered to your exact requirements—and we assume full responsibility for its performance.

Oxy-Catalyst works closely with all leading oven manufacturers. And new ovens can be designed with the catalyst as an integral part of the oven's heating system. So when you order new ovens, specify Oxy-Catalyst equipment.

If you would like to compare—to see for yourself the remarkably high efficiency of an Oxy-Catalyst installation—fill in this coupon, or write on your business letterhead, for complete information now.



Oxycat units were installed at the end of this vertical drying oven to oxidize troublesome solvent and varnish fumes at John A. Roebling's Sons Corporation, Electrical Wire Division Plant. This installation has been operating now for over 4 years.

OXY-CATALYST, INC.

Industrial Division · Wayne, Pa., U.S.A.

Fume Elimination Processes and Equipment: Industrial • Automotive • Consumer Products

Oxy-Catalyst, Inc., Industrial Division, Wayne 12, Pa.

Please send me complete information on your catalytic installations:

☐ For fume and odor elimination ☐ For waste heat recovery ☐ Have your representative call

Name_____

Firm Name_____

Street_____

City_____ Zone No._____ State_____

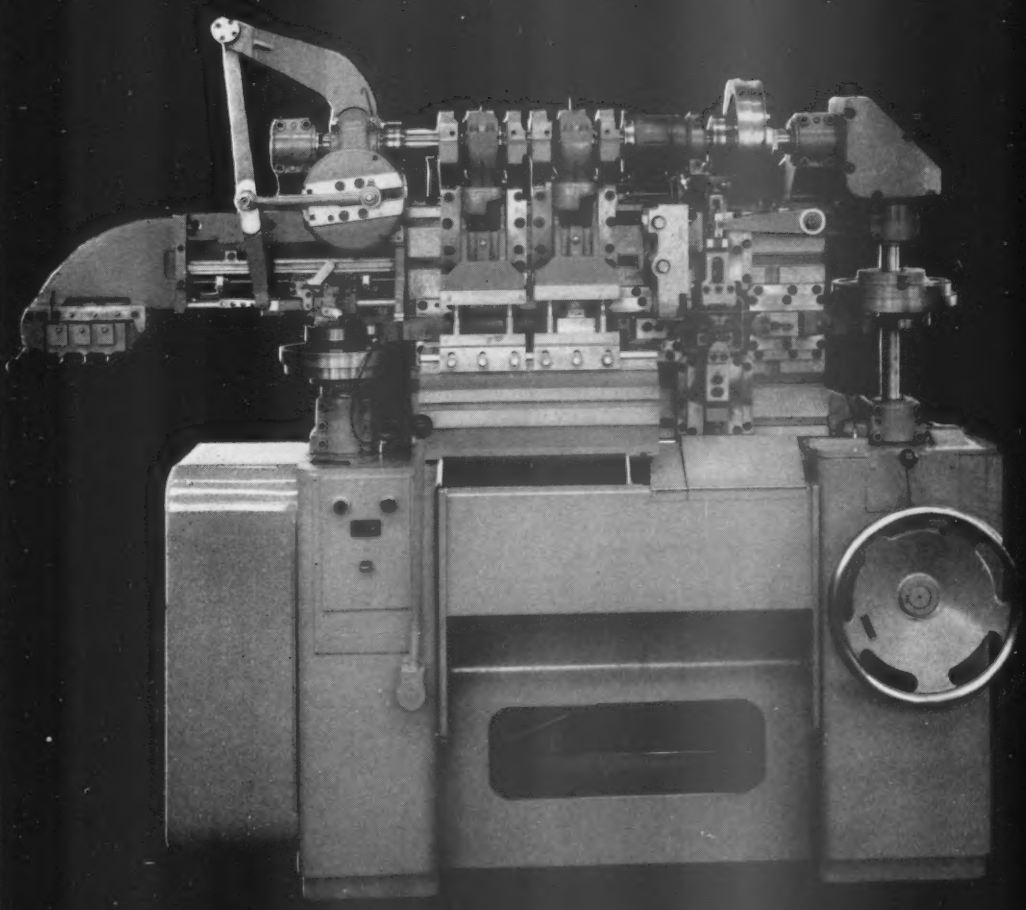
A Great New Vertical *4-Slide*

The Torrington Verti-Slide!

This important innovation in the basic field of 4-slide production equipment offers so many advanced design features, performance advantages and cost-cutting facilities that it is making national news as a development of major interest to U. S. industry.

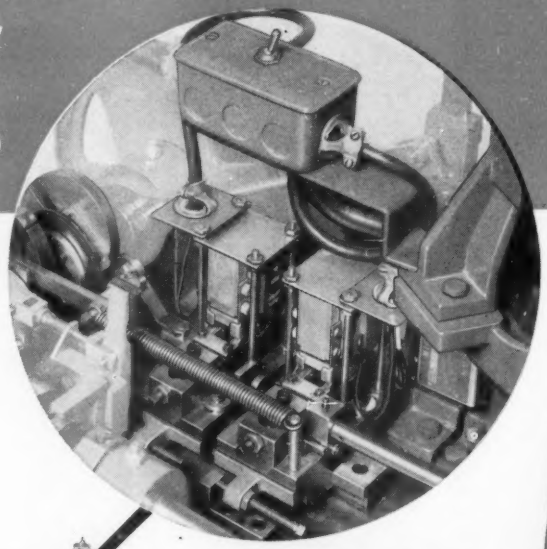
NATIONAL NEWS

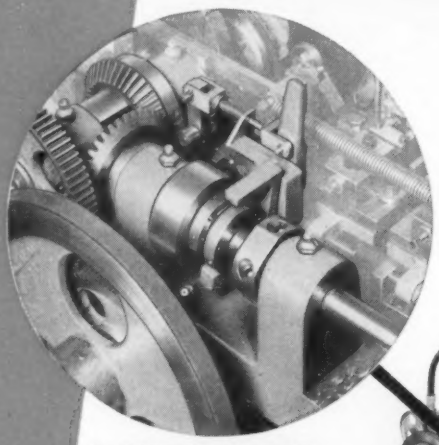
For the Torrington *Verti-Slide* was designed to meet a fundamental need for greater versatility, lower tooling cost, faster set-up time and reduced floor space. We urge you to investigate the *Verti-Slide* in detail at the Metal Show, Booth 1567, or through direct communication with our Machine Division.

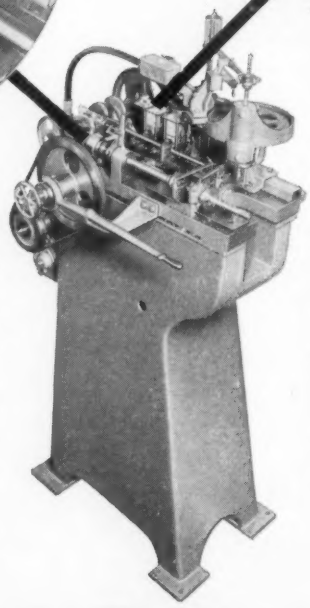


THE TORRINGTON MANUFACTURING COMPANY

2 BIG, NEW FEATURES







"AUTO-SPEED CAMMING"

With this new built-in feature, the obstacle of limited forming time is overcome.

The cams rotate seven times faster which allows more forming work during recoil, and reduces secondary operation costs.

It also offers quick power testing of tool set-ups before running.

The machine can be converted easily to standard camshaft operation.

"ELECTRO-GRIP SLIDE-FEED"

with reciprocating cutter tube

Highly accurate wire feed is made possible by adjustment against positive stops.

Spring tension eliminates slack and play in the slide movement.

The reciprocating cutter tube accurately guides wire to the arbor driving pin and holds wire during winding.

The machine has a separate switch for gripping and releasing wire for convenience in threading.

#0 Torsion Spring Machine, 607 Series

Here is the most advanced model of a standard production machine from the pace-setting manufacturer of spring coiling machinery. Easier to operate, it gives you greater accuracy and increased work performance and offers you more advantages than any other torsion spring machine made. This and other models in S&H's complete line of torsion spring machines have these two all-important built-in features.

S&H Torsion Spring Machines are also manufactured with "across the front" camshafts.

Write for latest information...

S&H

EST. 1911

SLEEPER & HARTLEY INC.

BOX 1249, WORCESTER, MASS., U. S. A.

ORIGINAL MANUFACTURERS OF UNIVERSAL SPRING COILERS

it's **easy**

to recognize

superior quality

brass and aluminum

bearing this trademark identification

bring out the ***BEST*** *in your fabricated products*

SCOVILL

SCOVILL MANUFACTURING COMPANY
MILL PRODUCTS DIVISION, 99 MILL ST.
WATERBURY 20, CONN. PHONE PLAZA 4-1171

SCOVILL WIRE

COPPER-BASE ALLOY

available in . . .

payoffpak

Here is one of the most important and practical "differences" Scovill has made available to wire formers. PAYOFFPAK is the NEW optional (without extra cost) method for packaging Scovill Copper-base alloy Wire, resulting in immediate time and cost-saving advantages to you. Check these advantages listed below . . . then get in touch with us at Waterbury, or at your nearest Scovill sales office listed below.

WIRE IS FED DIRECTLY FROM DRAWING MACHINE INTO PAYOFFPAK.

SHIPPED TO CUSTOMERS FULLY PROTECTED, CLEARLY LABELED . . . EASY TO INVENTORY.

SCOVILL'S WIRE PAY-OFF FEEDER ELIMINATES REELS OR SPOOLS.

LONG CONTINUOUS RUNS from UP TO 500 lbs. of wire in a single strand . . . with assured smooth-running pay-off, from the first foot to the last.

READY-TO-FEED pay-off to wire forming machines **eliminates** reels or spools.

LESS DOWN-TIME between runs . . . no small coils to change constantly.

MUCH EASIER HANDLING and storage . . . PAYOFFPAKS can be stacked.

PROTECTION to wire in shipment and storage.

NO EXTRA COST. Any Scovill Copper-base alloy Wire may be ordered delivered in the PAYOFFPAK in the following sizes and tempers: Diameters .016″ to .060″ inclusive any temper except SOFT. Diameters over .060″ to .212″ inclusive SOFT temper to 2 Nos. HARD.

SCOVILL

SCOVILL MANUFACTURING COMPANY, WATERBURY 20, CONNECTICUT

BOSTON AREA: 1116 GREAT PLAIN AVENUE, NEEDHAM 92, MASS.
CHICAGO 51, ILLINOIS: 4105 WEST CHICAGO AVENUE
CINCINNATI 15, OHIO: 2330 GLENDALE-MILFORD ROAD, EVENDALE
CLEVELAND 11, OHIO: 4635 WEST 160TH STREET
DETROIT 35, MICHIGAN: 19455 JAMES COUZENS HIGHWAY
ELM GROVE, WISCONSIN: 13300 WATERTOWN PLANK ROAD
GREENSBORO, NORTH CAROLINA: 1108 EAST WENDOVER AVENUE
LOS ANGELES 22, CALIFORNIA: 6464 EAST FLOTILLA STREET
NEW YORK 17, NEW YORK: CHRYSLER BLDG., EAST, 161 E. 42ND ST.
PHILADELPHIA 43, PENNSYLVANIA: 2536 SOUTH 59TH STREET
PITTSBURGH 16, PENNSYLVANIA: 2882 WEST LIBERTY AVENUE
PROVIDENCE 3, RHODE ISLAND: 183 PUBLIC STREET
ROCHESTER 6, NEW YORK: 175 DODGE STREET
SAN FRANCISCO 7, CALIFORNIA: 434 BRANNAN STREET
STURGIS, MICHIGAN: 410 WEST CONGRESS STREET

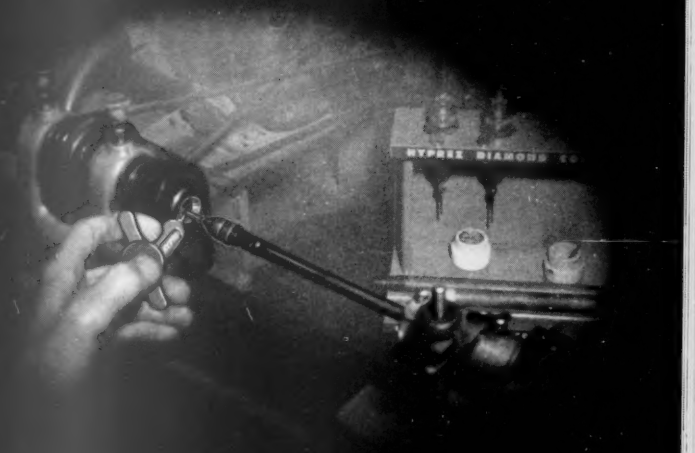
20SC57

for longer die life SUPERIOR TUBE COMPANY finishes with HYPREZ

HYPREZ
DIAMOND COMPOUNDS
for flawless lapping and polishing

In the Norristown, Pa., plant of Superior Tube Company, many hundreds of high-precision drawing dies must be finished and constantly maintained for maximum production.

Superior has found that long die life and top performance result from the use of Hyprez. These compounds comprise diamond particles of exact grading and concentration in a vehicle that assures permanent suspension and maximum finishing action. Hyprez Diamond Compounds are available in a complete range of grades from coarsest to finest.



From roughing to polishing, Hyprez Diamond Compounds produce finer finishes faster.

To finish any contour or detail, the Di-Profiler saves hours of expensive hand labor.

Di-Profiler
RECIPROCATING HAND MACHINE
saves time on detail and irregular surfaces

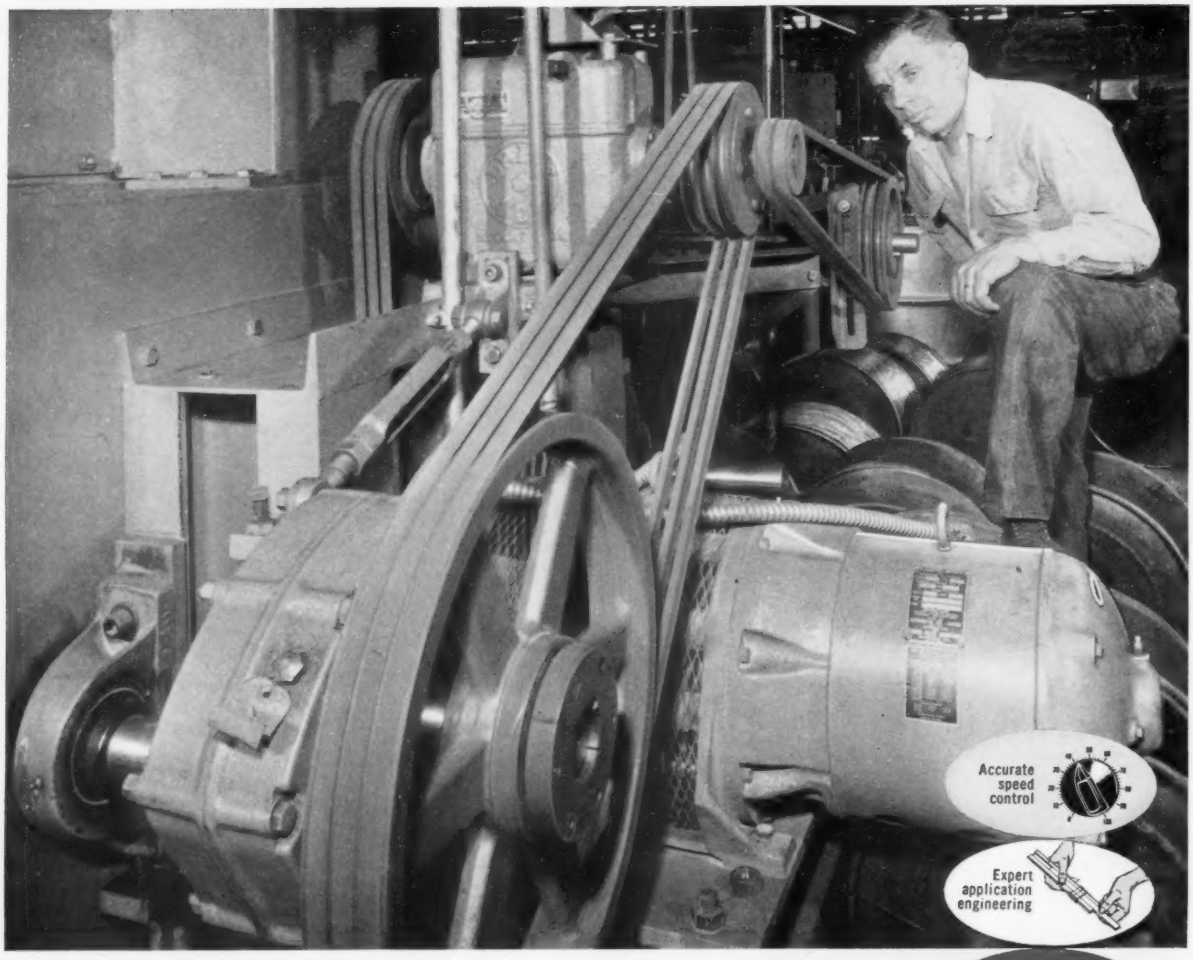
At Superior Tube Company, as well as in die, mold and tool shops throughout the country, the Di-Profiler has demonstrated important cost reductions in cutting, lapping and polishing operations on regular or irregular dies. This machine saves tedious hours of manual labor, especially on curved or fine detail jobs.

A variable stroke of 0 to 6 mm. (¼"), at a controllable speed of 0 to 100 per second—together with a complete assortment of cutters, files, discs, points, burrs, and scrapers—offer a versatility that makes the Di-Profiler economical for every type of precision job.

Ask for free demonstration or Technical Bulletin No. HDW-107

ENGIS EQUIPMENT COMPANY

431 SOUTH DEARBORN ST. • CHICAGO 5, ILL.



Louis Allis drives double production at Central Cable Company

Ajusto-Spede® drives improve extruding operation — cut costs 75% — slash rejects 90%

Central Cable Company, of Freeport, Illinois, is a major manufacturer of utility cable. In recent years they decided to improve their cable insulation by going to the extrusion process.

To power their extrusion lines, they found that of all the drives available, Louis Allis Ajusto-Spede® A. C. drives offered the greatest flexibility and precise speed control. Result: production increased 100% . . . manpower costs dropped from $240 to $60 per day . . . rejection rate because of improper insulation dropped from 10% to less than 1%.

Adjustable speeds from 0 to 1400 fpm permit coating of varying cable sizes without changing mechanical set-up. Precise "one-dial" master speed control assures positive speed relation between extruder, capstan, and takeups—permits uninterrupted processing — maintains proper wire tension from initial feed through windup on shipping spools.

In addition, Louis Allis drives are controlled by one potentiometer, eliminate need for ac-dc converter. Equally important, the Louis Allis drives at Central Cable Company have not had a single breakdown since their installation in 1948 — nor have they required replacement or repairs of any kind.

For modernizing — or a new installation — consult Louis Allis *first*. Contact your nearby Louis Allis District Office or write to The Louis Allis Company, 451 East Stewart Street, Milwaukee 1, Wisconsin.

LOUIS ALLIS

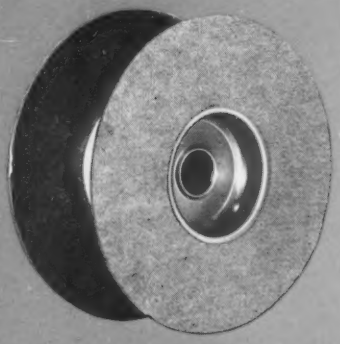
MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

HUBBARD HAS IT

If it's a spool or reel, HUBBARD makes it.

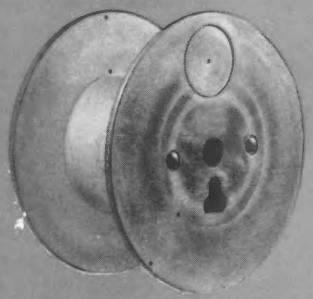
Every type: Wood - Steel - Plywood - Masonite - Cardboard - Aluminum.

HUBBARD is headquarters for any reel or spool requirement.



Reel with a masonite flange and cardboard hub assembled with steel end washers for domestic and export shipment of wire, tape, braid or other materials.

Heavy Duty Precision Brazed Steel Spool for drawing and processing of wire. Strongly and accurately made for long service.



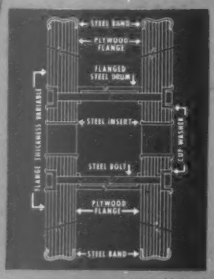
Non-Returnable Magnet Wire Shipping Reels designed for High-speed wire take-off. Light in weight, low in cost, high in impact and tensile strength. Ideal for palletized shipments.

PLYWOOD MARRIES STEEL

FOR BETTER SHOP REELS RESULTING IN

1 GREATER IMPACT STRENGTH

2 LOWER MAINTENANCE COSTS

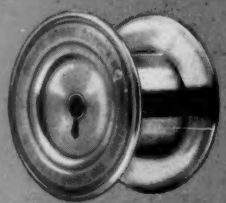


3 LIGHTER WEIGHT FOR EASIER HANDLING

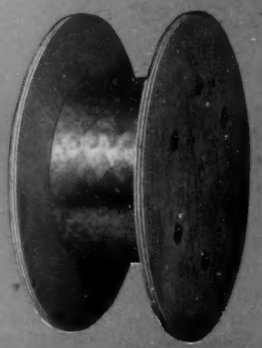
4 ABILITY TO WITHSTAND SUBMERGENCE IN WATER

5 WIDE RANGE OF SIZES

Top quality wood reels armored with galvanized steel for minimum strength and long hard service.



Aluminum Reels designed for customers' appeal. Heads are strong. All welded construction. Smooth surfaces. Tare weight uniform. Ideal for bulk shipping.

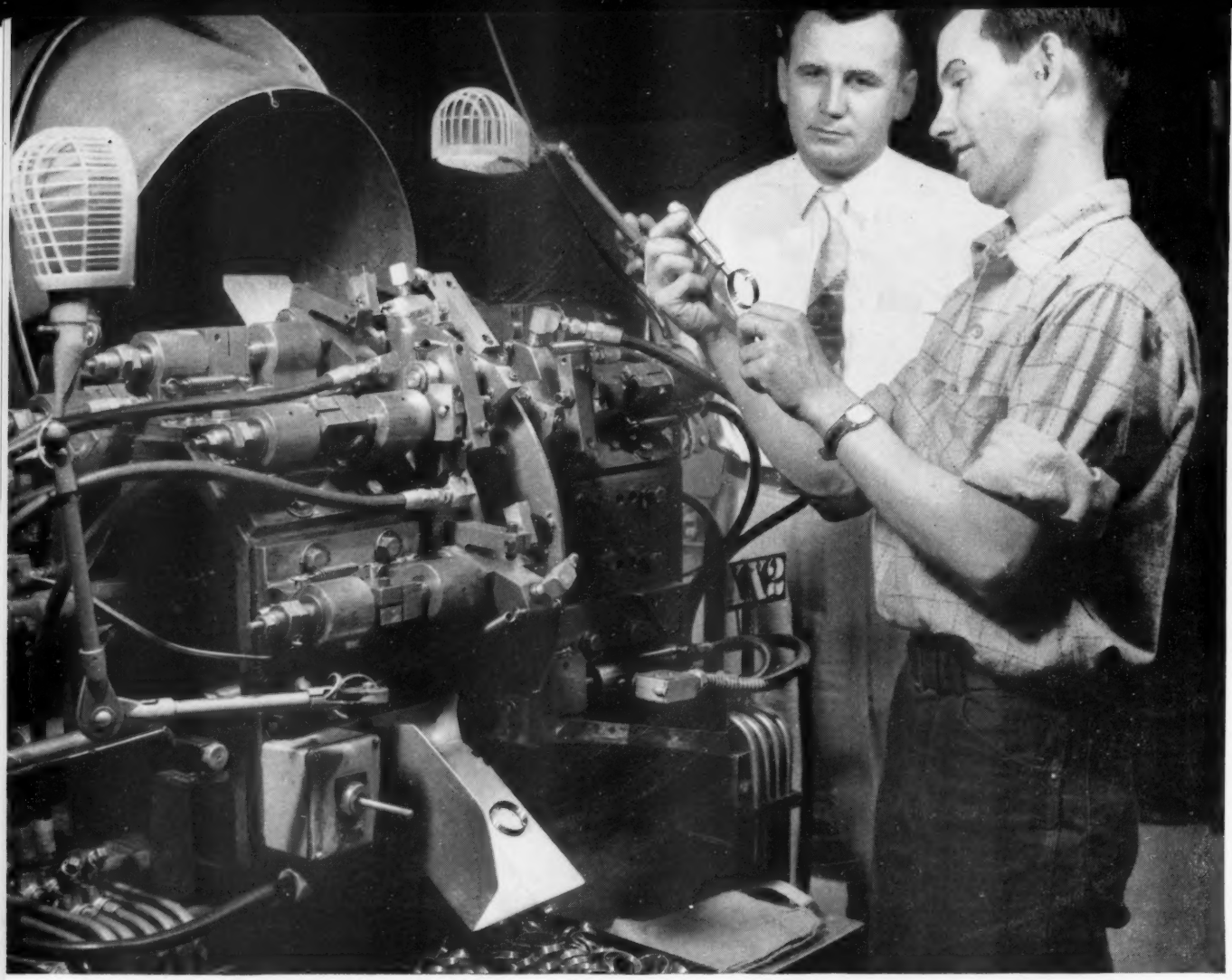


Reel with plywood flange and galvanized steel hub assembled with tubular rivets and special washers for heavier loads.

Steel Shipping Containers. Wire Pak pails featuring top and bottom support for inner core. Smooth seams throughout. Tops available with lug or ring seals. Have salvage value.

HUBBARD SPOOL CO.

GARRETT, INDIANA Tel.: GArrett 340



William Kody, American Coil Spring sales manager, watches as important product receives periodic check. An automobile window regulator clutch spring, it must be very precise. Johnson music spring wire fits product and machine.

Johnson Music Wire meets the test at American Coil Spring Company where . . .

Automation Demands Uniform High Quality

When American Coil Spring Company needed a precise music spring wire for an exacting auto window regulator spring, past experience prompted it to turn to Johnson Steel & Wire Company, a leading producer of high-carbon fine-specialty wires.

And when the same company—for 32 years one of the nation's top precision springmakers—was looking for ways to further automate its Muskegon, Mich., plant, Johnson came up with another answer—extra-sized coils of weld-free music wire to reduce machine downtime and wire handling.

One of the largest spring wire users in the United States, American Coil has a company watchword—Springs With a Pedigree. Everyone at American Coil lives up to this slogan by constantly emphasizing quality in every phase of production. This has paid off for American Coil by building a reputation for making the best of standard springs—and special springs others can't make.

Every bit of American Coil's skill comes into play on the auto window regulator spring. The spring has to have perfect diameter because it is mechanically inserted in the window clutch during an automatic assembly. Too large, and the spring won't fit. Too small, and it will cause slippage when the window is raised or lowered. Either variation in dimension will cause rejection.

To make the spring, which has three turns and is close wound with extended legs bent opposite, American Coil invented a special machine to combine the coiling and bending operations.

One-half of the challenge solved by the machine, American Coil then had to find a superior wire. Cast and peak had to be exactly as specified. Uniform dimension of .055″ X-L-O music wire had to be held, both within the coil and from coil to coil. Excellent surface was another must. Johnson's X-L-O music wire met these specifications readily. It is available in a full range of sizes between .003″ and .300″ and can be given a number of phosphate or other surface coatings.

Meeting this customer's requirements through ingenuity and good wire is a formula American Coil applied in the case of the extra-sized coils.

Springs are periodically projected onto the screen of this shadowgraph so that minute details of their conformation are compared with drawings.

Operator prepares for a run of springs for automatic bowling alley pin setters. The Johnson music spring wire that feeds this machine comes in a special 500 lb. bundle so that run will be twice as long. Downtime is reduced.

American Coil is committed to a policy of automating wherever possible. In springs requiring Johnson's .080″ and larger music wire, Johnson doubled coil sizes from the traditional 250 pounds to 500 pounds without welds. This reduced storage space, simplified handling and reduced downtime on the coiling machines. Moves like this permit American Coil to achieve a daily capacity of 18 million pieces with a labor force that numbers usually 350 people.

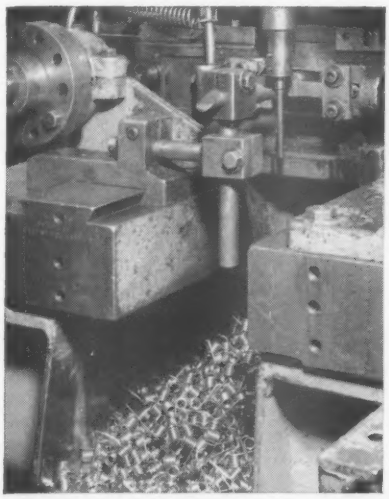
Of the relationship between American Coil and Johnson, Works Engineer James Church of American Coil says:

"The combination of our experience in springmaking and Johnson's superior knowledge of wiremaking, results in a highly successful product."

All these advantages of Johnson's wire are available to you, no matter whether you need music wire or any of the other specialties—

Aircraft Cord Wire . . Armature Binding Wire . . . Belt Hook Wire . . . Bobby Pin Wire . . . Brush Wire . . , Gutterbroom Wire . . . Card Wire . . . Shade Roller Wire . . . Flexible Shaft Wire . . . Heddle Wire . . . Hose Reinforcement Wire . . . Hose Wire . . . Mandolin Wire . . . Piano Wire . . . Rope Wire . . . Safety Pin Wire . . . Special Shaped Wire . . . Staple Wire . . . Metal Stitching Wire . . . Signal Corps Wire . . . MB Spring Wire . . . Tire Bead Wire.

If you have an application which requires high quality and close tolerances, Johnson is ready to serve you. Call your closest district office today.



Nobody watches this machine as it produces thousands of perfectly duplicated springs. If the wire were not highly accurate in dimension and metallurgical characteristics, frequent adjustments would be necessary.

Testing for tension is a constant operation at American Coil Spring. Variations in wire quality would show up here. American is well satisfied with Johnson music wire quality.

Johnson Steel & Wire Company, Inc.

Worcester 1, Massachusetts

a subsidiary of **Pittsburgh Steel Company**

Grant Building • Pittsburgh 30, Pa.

District Sales Offices

Atlanta	Cleveland	Dayton	Los Angeles	Pittsburgh
Chicago	Dallas	Detroit	New York	Tulsa
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Catalytic Combustion, eh? My oven builder tells me you people have developed some kind of catalyst that eliminates troublesome condensate, fire hazards, and recovers heat from exhaust fumes. Can you do this in one system?

Yes, sir—our Catalytic Process and "All-Metal" catalyst literally digests the combustible vapors and odors, leaving nothing but clear, clean gases—packed with heat for any desired use. The catalyst has no moving parts and its function is fully automatic.

PRES: Haven't catalysts been used in chemistry for years?

MR. CATALYTIC: Yes, sir—but our catalysts are different. They've been developed to operate with lower fuel input and to release more heat over a longer life span.

PRES: Longer life, eh—how long?

MR. CATALYTIC: We have catalysts still operating after 40,000 hours of trouble-free service.

PRES: Where are your Catalytic Units installed?

MR. CATALYTIC: They are used on every type of oven and furnace that releases hydrocarbon or combustible vapors. In the wire industry alone, there are over 800 Catalytic installations. Some larger units are processing over 80,000 CFM of exhaust gases.

PRES: This is worth investigating. Let's get the data you wanted.

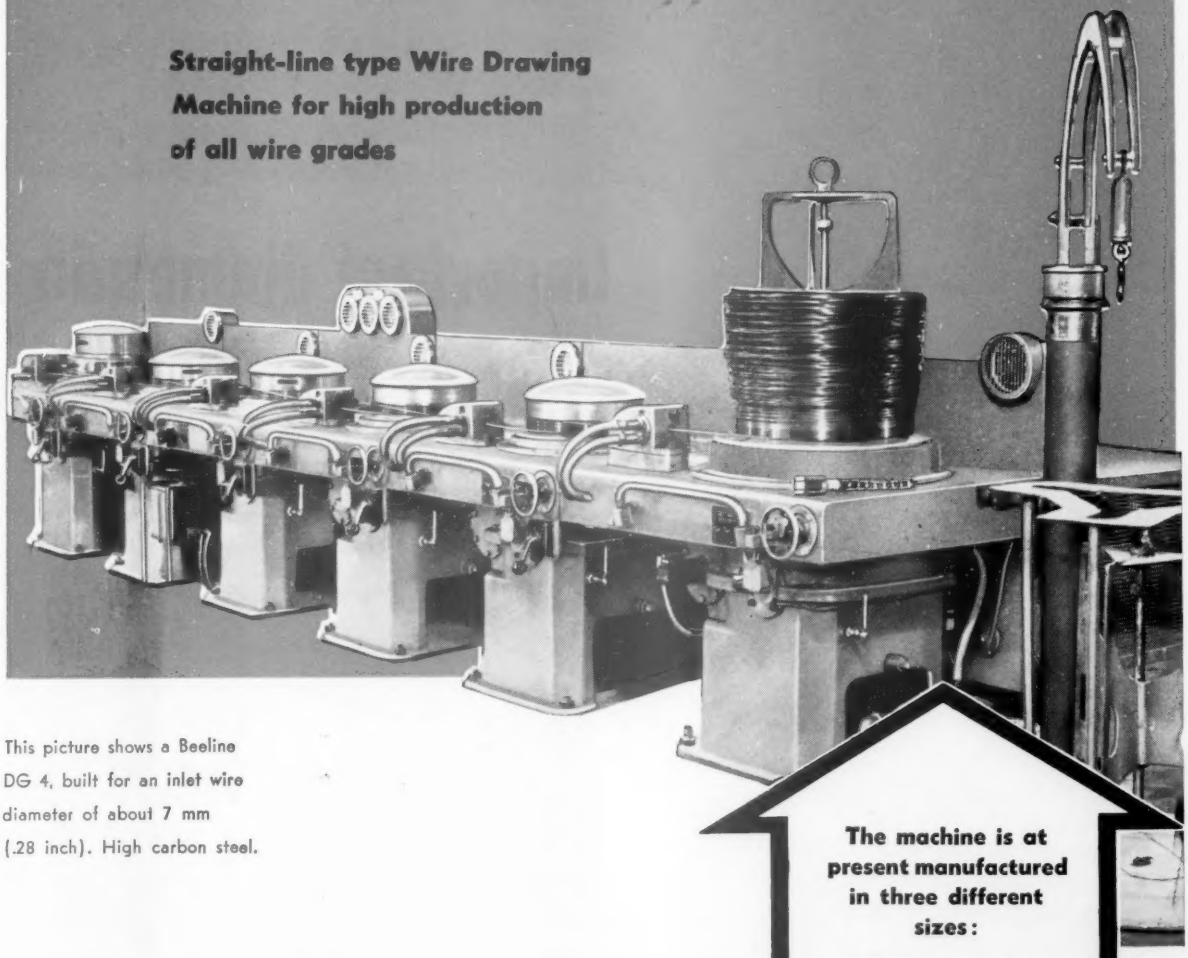
There's a Mr. Catalytic in all industrial areas. Write today for technical reprints or field demonstration.

CATALYTIC COMBUSTION CORPORATION

4706 Grand River Avenue, Detroit 8, Michigan

THE BEELINE WIRE DRAWING MACHINE

Straight-line type Wire Drawing Machine for high production of all wire grades



This picture shows a Beeline DG 4, built for an inlet wire diameter of about 7 mm (.28 inch). High carbon steel.

Prominent Beeline features:

- Complete absence of slipping between wire and block.
- Direct block-to-block wire running, with automatic speed control and no loops or other mechanical adjusting devices.
- Continuous speed adjustment from almost zero up to maximum.

Let us help you solve your problems. We shall be glad to answer your questions promptly. Don't forget to let us know what wire is to be drawn, the inlet and finished diameter, its intended use, the production required, and all other relevant information (tensile strength of the finished wire etc.). Then we can suggest a machine that is just right for you.

The machine is at present manufactured in three different sizes:

BEELINE DG 5

for heavy wire, about 13 mm. (.500 inch)

BEELINE DG 4

for wire rods, about 7 mm. (.28 inch)

BEELINE DM 3

for wire with an inlet diameter of wire of about 3 mm. (.116 inch)

MORGÅRDSHAMMAR

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Cables: Morgårdshammar, Ludvika. Tele: 0240–71100

NEW ENGLAND HIGH CARBON WIRE CO.

THE STEEL COMPANY OF CANADA, LIMITED

Union Wire Rope Corporation

CONTINENTAL STEEL CORPORATION

REYNOLDS WIRE

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COPPERWELD

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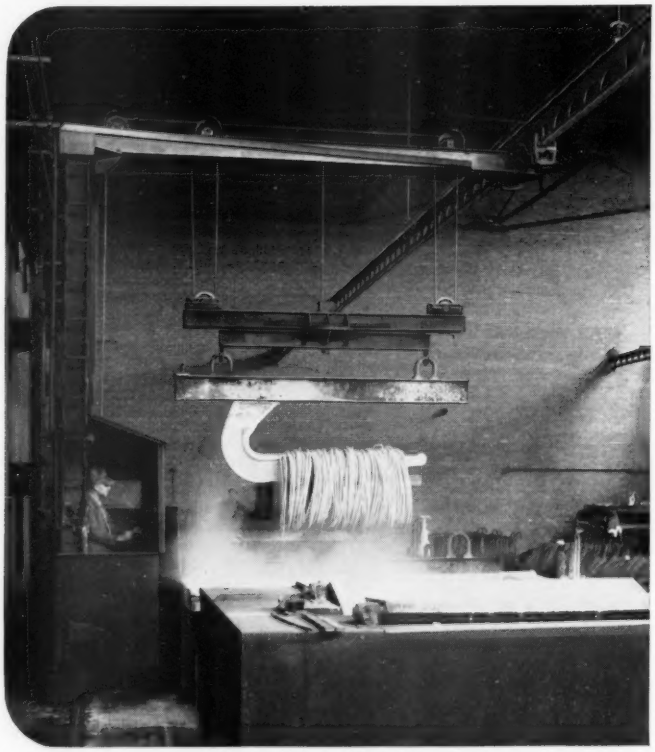
J&L STEEL

COLUMBIA-GENEVA STEEL DIVISION UNITED STATES STEEL CORPORATION

RUSTLESS IRON AND STEEL CORPORATION

BETHLEHEM STEEL

Important Names in the W



THE NATIONAL SCREW & MANUFACTURING CO.

Thompson Wire Company

CF&I-WICKWIRE WIRE

MID-STATES STEEL & WIRE CO.

RUSSELL, BURDSALL & WARD BOLT AND NUT CO.

WYMAN-GORDON COMPANY

SHEFFIELD STEEL CORPORATION

CRUCIBLE STEEL COMPANY OF AMERICA

THE CLEVELAND CAP SCREW CO.

REPUBLIC STEEL

ROEBLING

Wire and Rod Industry

MOST companies in the wire and rod industry have swung over to the straight-line method of cleaning originated and developed by Cleveland Tramrail. Those represented here have one or more Cleveland Tramrail installations cleaning 75 to 950 tons per day.

When equipped with a Cleveland Tramrail gantry crane and arranged for straight-line production, a cleaning house is far more efficient. More wire or rod is cleaned faster at lower cost in the same floor area. Working conditions are healthier, cleaner, more orderly. A modern Cleveland Tramrail-equipped cleaning house soon pays for itself out of savings it makes possible.

CLEVELAND TRAMRAIL

Overhead Materials Handling Equipment

CLEVELAND TRAMRAIL DIVISION • THE CLEVELAND CRANE & ENGINEERING CO.
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ALLEGHENY LUDLUM

BUFFALO BOLT COMPANY

Ford Motor Company

GENERAL CABLE

WILBUR B. DRIVER CO.

WICKWIRE BROTHERS, INC.

THE SENECA WIRE & MFG CO.

JOHNSON STEEL & WIRE COMPANY, INC.

NATIONAL STANDARD COMPANY

WASHBURN WIRE COMPANY

Reid-Avery Company, Inc.

Die used for blanking round can ends. The Kennametal cut edge die is shrunk-fit in the steel case, as shown in sectional drawing (black represents Kennametal, while gray indicates steel).

Cut edge dies of KENNAMETAL* increase production 60 times or more

The performance of hundreds of can lid dies of various sizes made of Kennametal average 60 times more lids than produced with steel dies. These dies cover a range of sizes, including ends large enough for gallon cans. This means less downtime on the die presses, high production rates, and minimum maintenance costs.

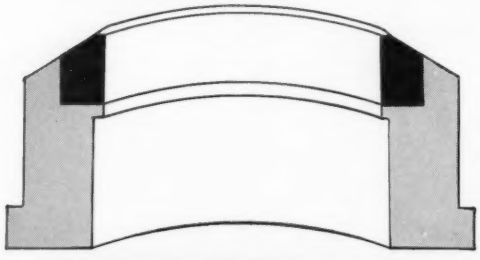
In one specific application, Kennametal dies and mating steel punches outperformed 35 previously-used steel die and punch sets before the first regrind was required. On another operation, nearly 800 million 3" lids had been produced by the time .020" of the stock had been ground from the original Kennametal cutting edge. These are typical examples of Kennametal cut edge die performance in plant after plant.

Choose Kennametal for your next die parts. With six grades in the "90 Series" and three grades in the exclusive "80 Series," for use where galling is a problem, there is a grade to meet the requirements of any die application.

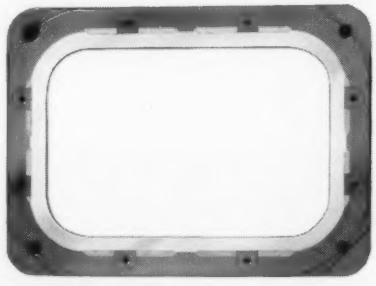
A Kennametal die engineer will gladly work with you or your die maker in applying the correct grade of Kennametal for your dies. Call him at your nearest Kennametal office or write to KENNAMETAL INC., Latrobe, Pennsylvania.

*Trademark

C-3032

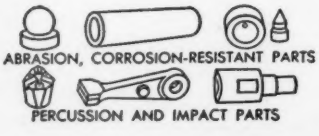


A one-piece Kennametal cut edge die is shrunk and pressed into steel casing.



A combination of shrink-fit of Kennametal cut edge die and mechanical holding lugs is used on this die for blanking one-gallon turpentine can bottom pieces.

INDUSTRY AND KENNAMETAL ...Partners in Progress



A recent North American Installation

Take Up Frames for galvanised wires with stationary blocks or convertible to rotating action.

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EFFICIENT, MODERN SYSTEMS
FOR
ELECTRICAL WIRE & CABLE MANUFACTURING

• *CABLE LACQUERING SYSTEMS*

Conventional cellulosic, or other type, lacquers are applied in successive continuous coats from one to twenty-eight coats over fibrous braid wrapped primary conductors. One end, four ends, or eight ends of wire are handled continuously. System includes letoff, application, drying and constant tension takeup equipment.

• *WIRE ENAMELING SYSTEMS*

Natural and synthetic enamels, silicones, solution nylon, modified plastisol, and similar insulating coatings are applied to bare, cotton or glass covered wire in round, square or rectangular cross section. Ten or twenty simultaneous strands are handled. Systems are complete with letoff, preannealer, application system, capstan and multiple takeup unit.

• *ASBESTOS INSULATING SYSTEMS*

Carded asbestos is applied to continuous single conductor as an integrated operation with saturating, rotary forming, drying, cooling and polishing of the finished wire. Wire from No. 20 gauge to No. 6 AWG is handled through an asbestos wall thickness range of from .008″ to .040″ thickness in a single pass.

• *RUBBER OR PLASTIC JACKETING SYSTEMS*

Rubber and thermoplastic jacketing compounds are continuously applied to electrical wire or cable by the extrusion method. High speed, constant tension letoff and take up equipment, controlled cooling or continuous vulcanizing equipment are powered by synchronized range drives as complete, integrated wire handling systems. Extrusion machines of customer's choice are furnished.

• *GLASS & VARNISH COATING SYSTEMS*

Double layer of glass or cotton wrapping is applied to round, flat or square conductor. Two individual coatings of high temperature varnish are applied and the finish baked in a continuous operation. Units are complete from letoffs to takeup frames.

• *SELF TRAVERSING REEL CORD DRYERS*

These ingenious machines are used to remove hygroscopic moisture from fibers, braided or knitted flexible cable. These machines increase extrusion speeds, reduce blister scrap loss and improve diameter control. They are easily installed in existing extrusion line.

TECHNICAL INFORMATION ON ANY OF THESE PROCESSES UPON REQUEST

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Answers Tomorrow's Wire Marking Problems Today

GEM GRAVURE CO. INC.
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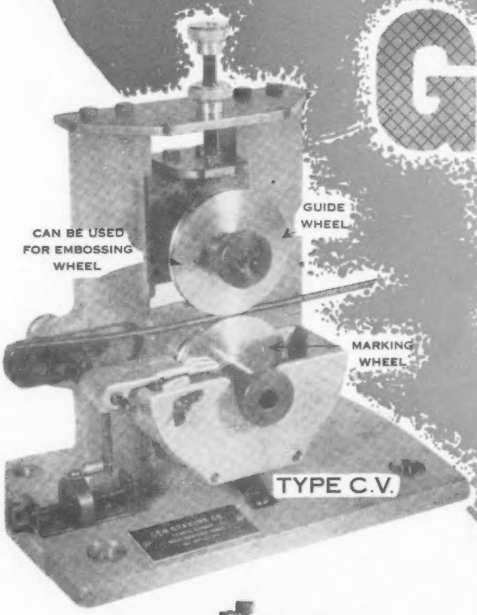

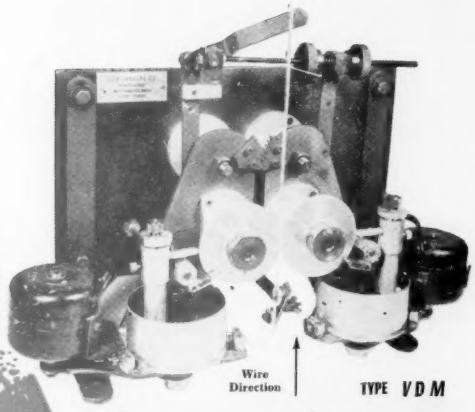

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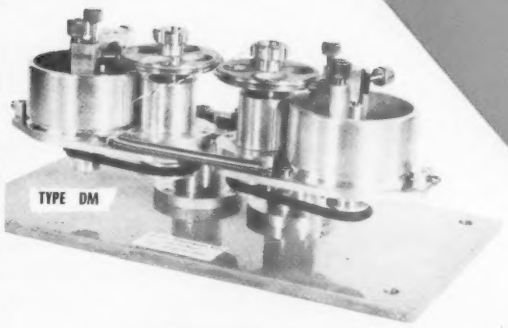
One filling of ink well, gives 18 **HOURS** of continuous simulated spiral striping, number coding or printing.

FOR HORIZONTAL DOUBLE PRINTING OR STRIPING ON PLASTIC OR RUBBER AT THE EXTRUDERS OR AS A SEPARATE OPERATION



INSULATED WIRE, HOSE, TUBING, WEBBING OR PIPE

FOR USE ON C. V.'S, PLASTIC EXTRUDERS, REGULAR INSULATORS, COILERS

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MARKING INKS HAVE PASSED ABRASION and SOLVENT RESISTANT TESTS

Actual Production tests show that 1 Pint of our Ink will mark 243,000 ft. of 14TW Wire using 3/64" type.

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HALFTONE PHOTO ENGRAVED MARKING WHEELS

FOR HOT OR COLD APPLICATIONS ON
POLY VINYL CHLORIDE • POLYETHELENE • NYLON
RUBBER, NATURAL • SYNTHETIC or CURE-IN-LEAD

NEW WINSTROM

★ *Electronic Sensing Switch*

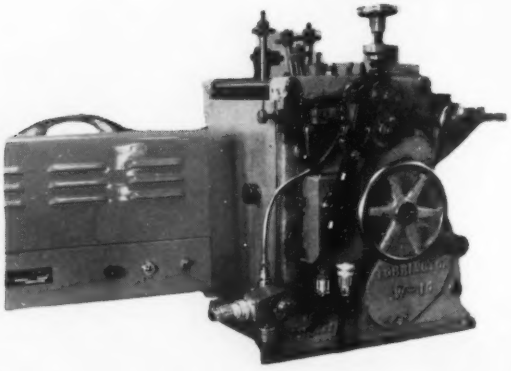
Model ESS-2

- SENSITIVE ELECTRONIC RELAY DESIGNED SPECIFICALLY FOR EASE OF INSTALLATION, NO MAINTENANCE, SUPERB RELIABILITY AND PACKAGED TO WITHSTAND THE HARDEST SERVICE TO WHICH COMPETITIVE INDUSTRIES CAN EXPOSE IT.
- TWELVE MODELS AVAILABLE TO MEET YOUR MOST EXACTING REQUIREMENTS.
- IDEALLY SUITED FOR USE ON CLUTCH-TYPE COILERS FOR TRIGGERING ELECTRIC CUT-OFF MECHANISM, INSULATION TESTING, DROP WIRE DETECTION, LIQUID LEVEL CONTROLS, SAFETY DEVICES AND HUMAN TOUCH CONTROL OF ELECTRONIC DEVICES.
- SEND FOR BULLETIN ESS-2, WHICH GIVES FULL DETAILS, INCLUDING RELAY COMBINATIONS, SENSITIVITIES, PRICES AND DELIVERY.

PROVEN WINSTROM

★ *Electronic Spring Gage*

Model SGO-1 and ESG



- THE NOW FAMOUS ELECTRONIC SPRING GAGE IS AVAILABLE FOR TORRINGTON UNIVERSAL SPRING COILERS W-10, W-11, W-100, W-10A, W-11A.
- THIS GAGE MEASURES EVERY SPRING AS COILED AND WILL SEPARATE GOOD SPRINGS FROM THOSE OUTSIDE A PREDETERMINED TOLERANCE.
- THE GAGE OPERATES AS RAPIDLY AS THE COILER CAN RUN WITH 100% INSPECTION OF FREE LENGTH.
- THREE GROUP SORTING IS AVAILABLE FOR SORTING SPRINGS PRIOR TO GRINDING.
- TEN MODELS AVAILABLE; SEND FOR DESCRIPTIVE LITERATURE.

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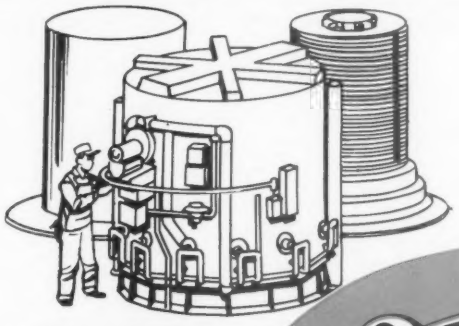

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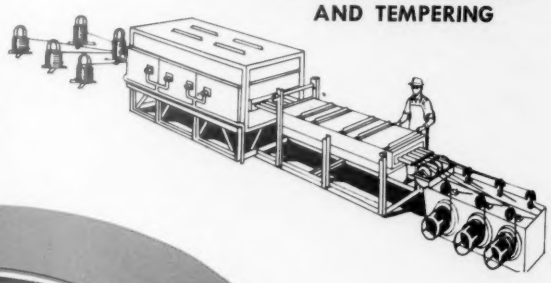

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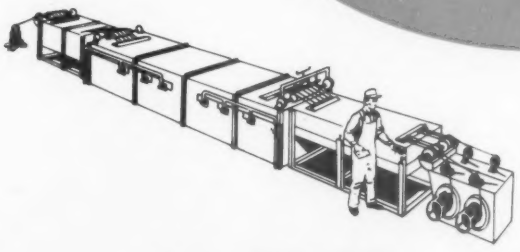

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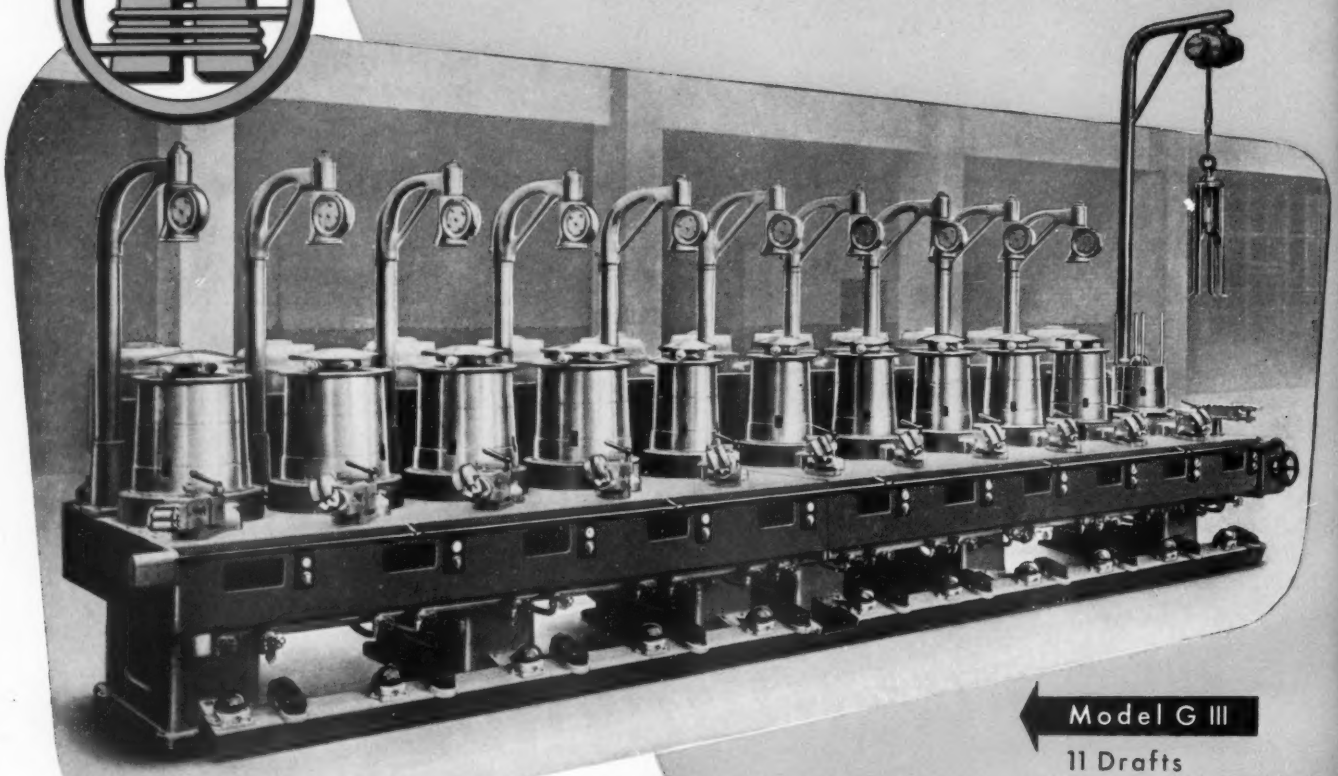

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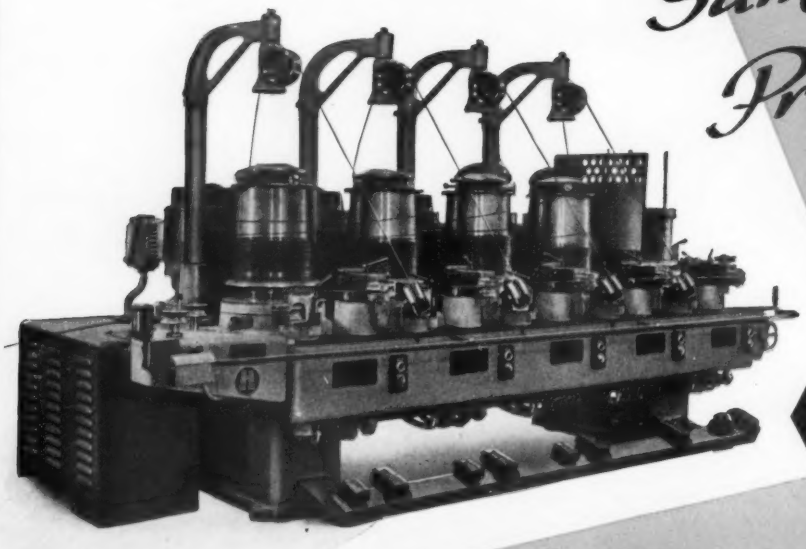
11 Drafts

Same Production, Half Space



Model G III d
5 Blocks =
10 Drafts

Your inquiries are kindly invited.

MASCHINENFABRIK HERBORN BERKENHOFF & DREBES A.-G.
OUR SPECIALTY: MACHINES FOR THE WIRE INDUSTRY • IRON FOUNDRY
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Memo to a Man of "Parts"

The number of different parts made from Roebling High Carbon Specialties, Flat Wire and Spring Steel are close to countless.

Some things you can count on, though, are the consistent dimensional and mechanical uniformity you get with any Roebling High Carbon Specialty. They are the qualities that contribute to speeding *your* production and cutting *your* costs.

They are high qualities that make for high values. Next time you need flat wire or spring steel, specify Roebling. Write Wire and Cold Rolled Steel Products Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation

Roebling... Your Product is Better for it

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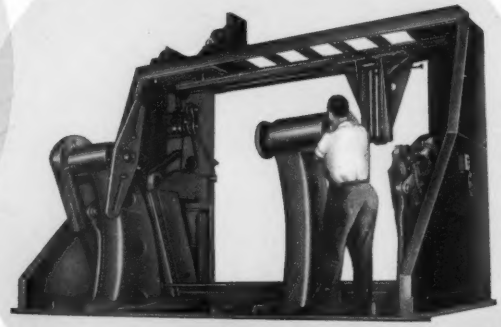
WITH DAVIS-STANDARD'S 120″ AND 96″ REEL PAY-OFFS AND TAKE-UPS

PAY-OFFS Pay-Offs have electromagnetic drag controlled by adjustable indicating dial.

MODEL 120 — 60″ to 120″ diameter reels up to 96″ wide. Capacity 30 tons.

MODEL 96-70 — 48″ to 96″ diameter reels up to 70″ wide. Capacity 15 tons.

MODEL 96-48 — Same as Model 96-70 except for 48″ maximum reel width.



TAKE-UPS Take-Ups have infinitely adjustable width of traverse and wire lay. 7:1 ratio of lay adjustment.

All units have pushbutton-operated dual screw lifts. Shaftless construction with pintles engaged to reel bore by handwheels eliminates positioning of heavy reels. Lateral adjustment of reel lift arm is power-operated. Reels are loaded and unloaded at floor level — no ramps required.

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We make them all

These tags suggest just a few of the many kinds of steel wire we make at our modern wire mills. Some are ordinary types of wire, others are for special purposes. And whether it's low- or high-carbon wire, bright, annealed, galvanized, or bethanized . . . we pay the strictest attention to all of the important details that mean top-quality steel wire.

At your convenience, we'd like to talk over your wire needs. Quite often we can help our wire customers to turn a problem into a profit. Just phone our nearest sales office for full details.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

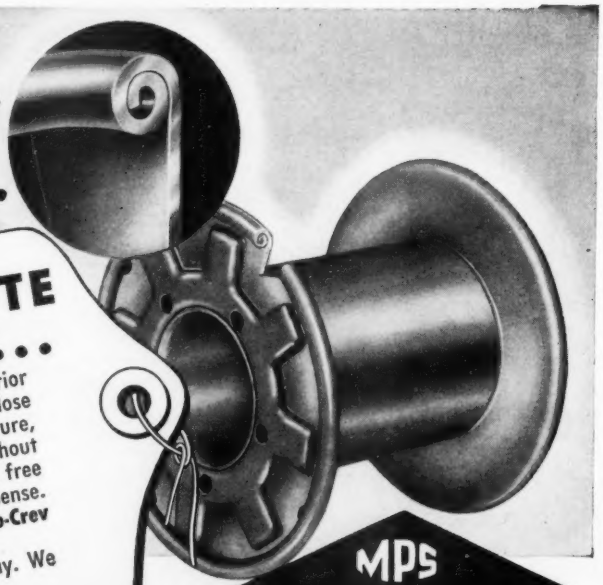
BETHLEHEM STEEL

Welcome

TO MEMBERS AND GUESTS
ATTENDING THE
1957 WIRE CONVENTION

YOU TOO SHOULD USE
SUPERIOR MPS SPOOLS AND REELS
WITH THE EXCLUSIVE HEAVY DUTY
CONVOLUTE DURA CURL RIMS

The Difference
IS HERE.....



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DURA CURL RIMS...

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Ask about MPS CONVOLUTE DURA CURL RIMS today. We invite your inquiries.

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give you brute strength with dimensional precision, concentricity, and balance. Another patented MPS development engineered to **help you!**

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4 PVC resins for electrical application

1 MARVINOL® VR-22
A medium-high-molecular-weight resin for hot dry-blend extrusion. Has excellent electrical properties, *high tensile* and *elongation*, outstanding *abrasion resistance*, and inherent heat stability. Approved by the Underwriters' Laboratories, Inc., for electrical applications.

2 MARVINOL VR-23
A medium-molecular-weight, easy-processing resin for hot dry-blend extrusion. Gives fast extrusion rates at low power consumption. Has superior electrical properties and excellent heat stability. Wire extruders report that Marvinol VR-23 makes *whiter* compounds. Approved by Underwriters' Laboratories, Inc.

3 MARVINOL VR-24
A medium-low-molecular-weight, easy-processing resin with very high bulk density. Useful in *semi-rigid* compounds for insulation of low-voltage and communications wiring.

4 MARVINOL VR-25
A low-molecular-weight resin ideally suited to unmodified *rigid* PVC electrical applications.

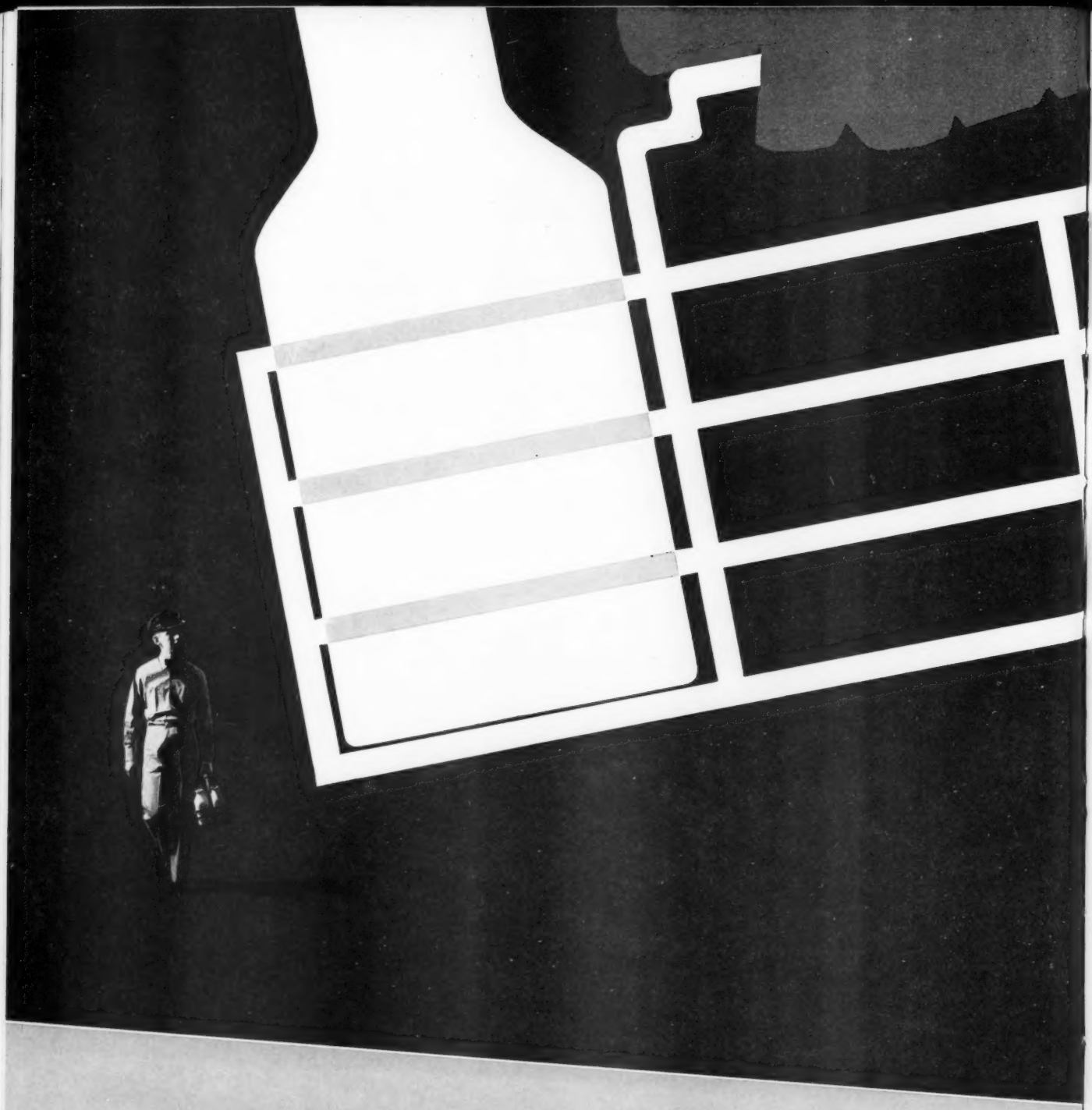
US RUBBER

United States Rubber

Naugatuck Chemical Division, NAUGATUCK, CONNECTICUT

Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices

BRANCHES: Akron • Boston • Gastonia, N. C. • Chicago • Los Angeles • Memphis • New York • Philadelphia • **CANADA:** Naugatuck Chemicals, Elmira, Ont. • **CABLE:** Rubexport, N.Y.



a profitable idea!

You'll sell more by telling your customers that your product is made from lightweight, rustproof Alcoa® Aluminum. When you knock down the weight a man has to carry or push all day, he'll be less tired, able to do a better job. If you use wire in your product, check into the advantages of aluminum.

Alcoa has set up a special department to work with you on profitable new ideas, new uses for aluminum wire. For immediate action, write ALUMINUM COMPANY OF AMERICA, Wire Products Development, 875-K Alcoa Bldg., Pittsburgh 19, Pa.

ALCOA ALUMINUM WIRE PRODUCTS

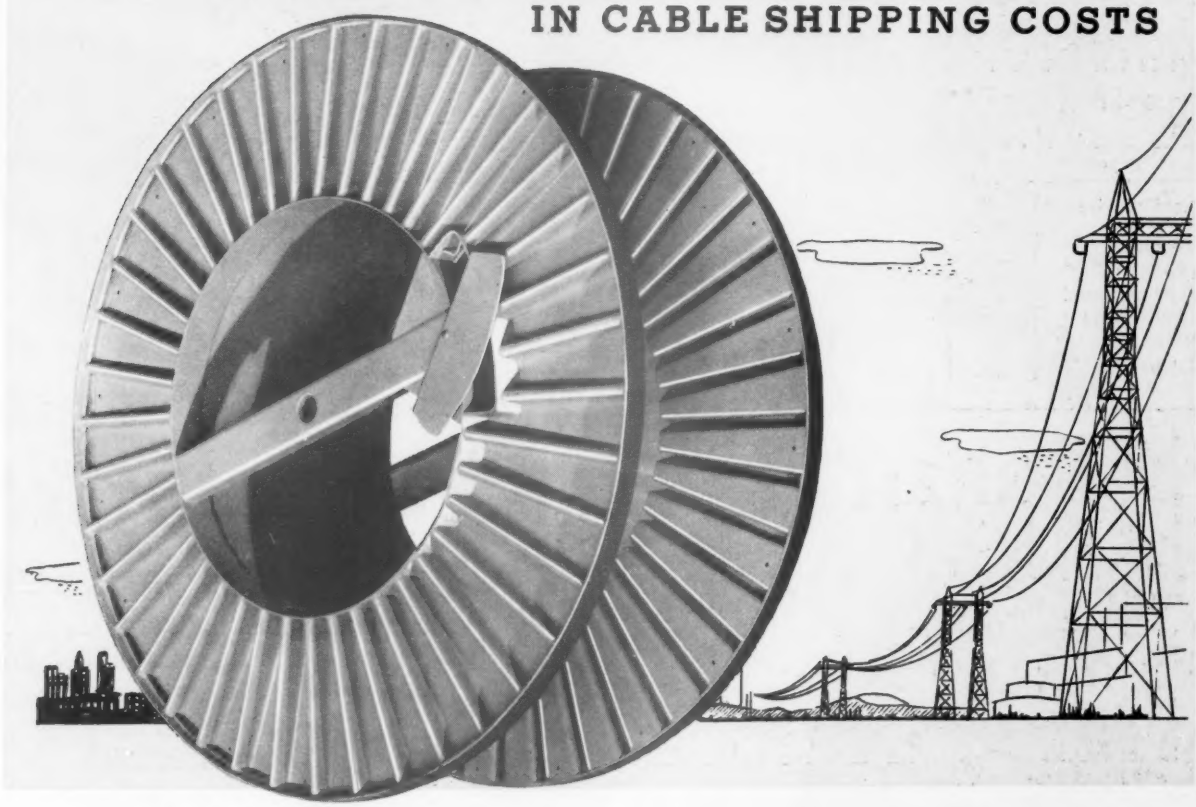
Your Guide to the Best in Aluminum Value

NEW! "ALCOA THEATRE" • Exciting Adventure • Alternate Monday Evenings

20-YEAR RECORD REVEALS

GREAT REDUCTION

IN CABLE SHIPPING COSTS



EVANS LIGHT WEIGHT

TOROIDAL METAL REELS

25% AVERAGE WEIGHT SAVINGS PER REEL

Toroidal design helps cut weight and freight costs to a minimum. Permits easier, faster, lower cost handling.

OUTLASTS 5 WOOD REELS

Evans metal reels have a proven service life of 20 reel trips. Many thousands of these reels have *lasted over 50 trips.*

CUTS MAINTENANCE COSTS

Cost records show Evans reels effect a 50% savings over wood . . . when Evans special repair kit is employed.

For more complete information write to Chicago Sales Office: 208 South LaSalle Street.

THE GEORGE EVANS CORPORATION
MOLINE, ILLINOIS

3 COMPLETELY NOVEL MACHINES FOR THE FABRICATION OF SCREWS FOR WOOD AND IRON

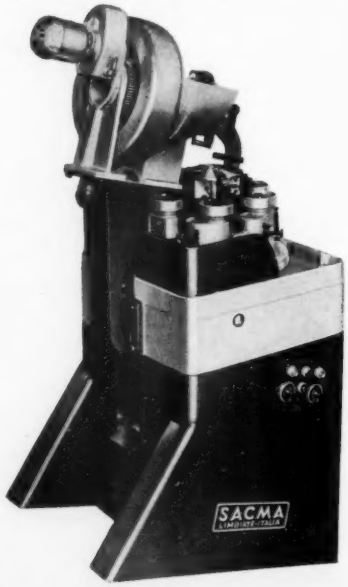
PATENTS REGISTERED

Press for double blow upsetting, open and closed Type SP

Type		SP 1	SP 2
Diam. of wire	mm.	1.4÷5	3÷7
Length of shank	mm.	8÷40	10÷60
Units produced per minute	n.	160÷180	140÷150
Power	HP	3	5
Net weight	Kg.	2000	3000

Forming operations automatically performed simultaneously. Type FV/V

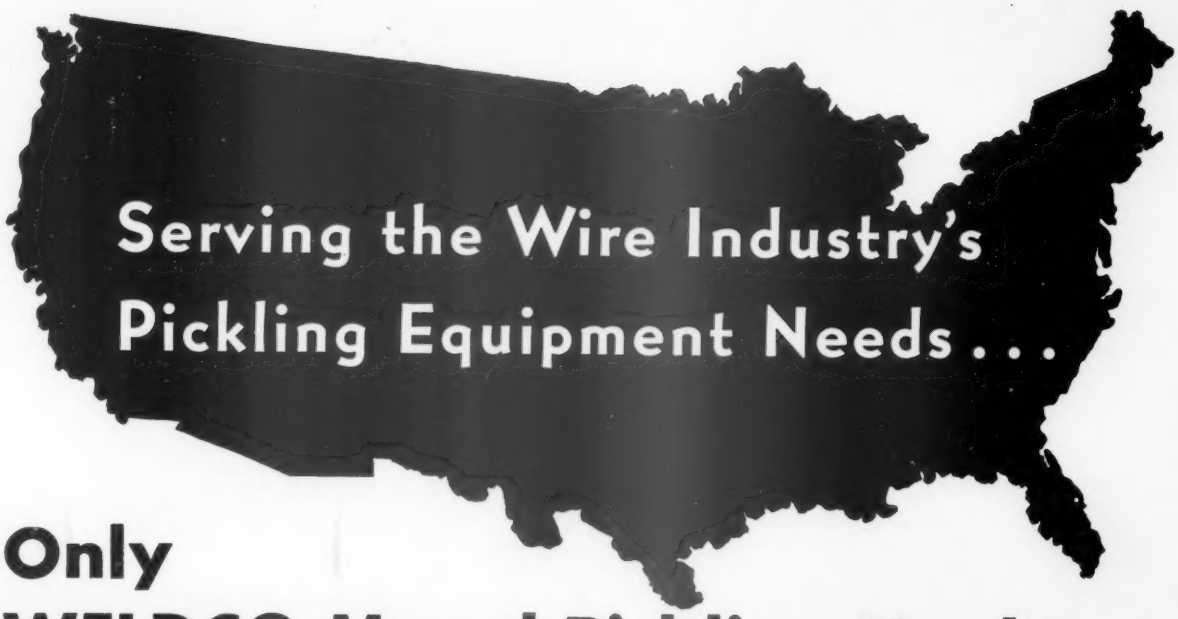
Type		FV1/V	FV2/V	FV3/V
Diam. of screw	mm.	1.4÷2.6	2÷4.5	3.5÷6
Length of screw	mm.	5÷30	10÷50	15÷80
Units produced per minute	n.	22÷40	18÷30	10÷25
Power	HP	0.75	1	1.5
Net weight	Kg.	360	450	580



Automatic head-forming of screws for wood and iron. Type ESAMATIC

Type		Esamatic 1	Esamatic 2
Diam. of shank	mm.	1.4÷4	3.5÷7
Length of shank	mm.	8÷50	10÷80
Units produced per minute	n.	300÷400	200÷300
Power	HP	1.75	2.25
Net weight	Kg.	600	750

sacma limbiate (milano) italia



Serving the Wire Industry's Pickling Equipment Needs...

Only WELDCO Monel Pickling Hooks Have Such Universal Acceptance!

OTHER WELDCO PICKLING EQUIPMENT

Mechanical Picklers, Crates, Baskets, Racks, Chain, Steam Jets, and Accessories

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American Steel & Wire Company - - - - - - Joliet, Ill.
American Steel & Wire Company - - Worcester, Mass.
Bethlehem Steel Corporation - - Sparrows Point, Md.
Bethlehem Steel Corporation - - - - Williamsport, Pa.
Detroit Steel Corporation - - - - - - Portsmouth, Ohio
Electric Auto-Lite Company - - - - - Port Huron, Mich.
Indiana Steel & Wire Company - - - - - Muncie, Ind.
Johnson Steel & Wire Co. - - - - - - Worcester, Mass.
Jones & Laughlin Steel Corporation - - Aliquippa, Pa.
Keystone Steel & Wire Company - - - - - Peoria, Ill.
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National Screw & Manufacturing Co. - Cleveland, Ohio
Pittsburgh Steel Company - - - - - - - Monessen, Pa.
John A. Roebling & Sons Company - - - Roebling, N. J.
Timken Roller Bearing Company - - Gambrinus, Ohio
Union Drawn Steel Division - - - - - Massillon, Ohio
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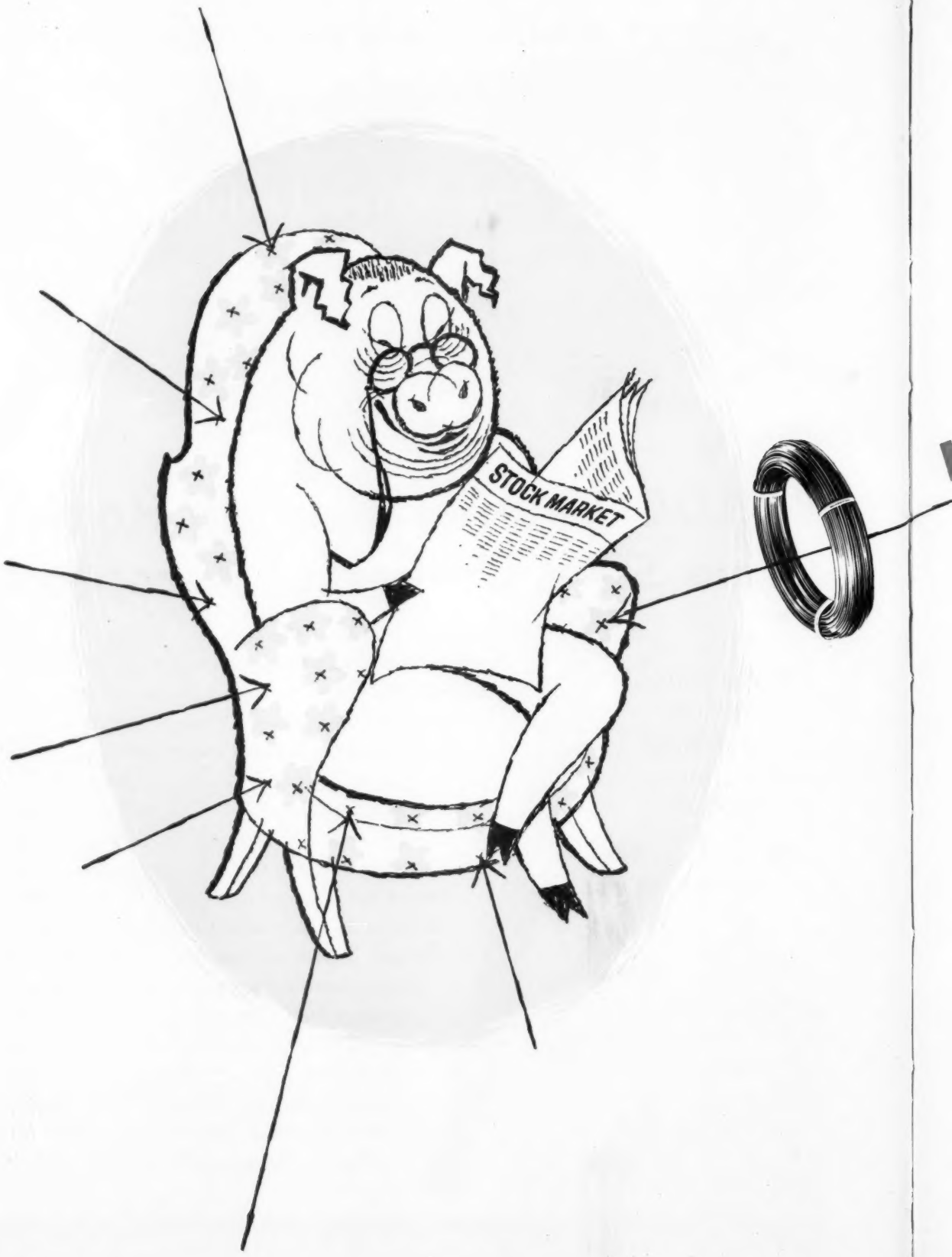
Wickwire Spencer Steel Division - - - Buffalo, N. Y.

THE YOUNGSTOWN WELDING & ENGINEERING COMPANY
3724 OAKWOOD AVENUE · · YOUNGSTOWN 9, OHIO


STOCK MARKET

hog rings that never see a hog

Not all hog rings are used to keep hogs from rooting up the ground with their snouts. One type is used by upholsterers to fasten burlap and similar materials. These rings are often made from a special hard drawn, low carbon CF&I-Wickwire Wire which is free from surface imperfections and wire-drawing lubricants.

Chances are you don't need wire to make hog rings. But *you may need one or more of the nearly 100 different categories of specialty wire for which CF&I-Wickwire is famous.* Let us show you how we can meet your most rigid chemical and physical specifications on high and low carbon wire in all sizes, shapes, tempers, finishes and grades. Remember—
FOR THE WIRE YOU REQUIRE, SEE CF&I-WICKWIRE.

Check This List!

FOR THE WIRE YOU REQUIRE, SEE CF&I-WICKWIRE.

FLAT AND SHAPED WIRES
Armor Wire
Bobby Pin Wire
Bookbinder Wire
Brush Wire
Casing Wire
Cotter Pin Wire
Curtain Spring Wire
Die Spring Wire
Gutter Broom Wire
Lock Spring Steel
Rake Tine Steel
Regulator Spring Wire
Snake Fishing Steel
Stapling Wire for Preformed Staples (Flat)

LOW CARBON FINE AND SPECIALTY WIRE
Bee Wire
Bonnet Wire
Bookbinder Wire
Broom Wire
Clip Wire
Dent Spacer Wire
Drapery Pin Wire
Florist Wire
Fuse Wire
Glass Netting Wire
Hairpin Wire
Hook and Eye Wire
Mattress Wire
Picture Cord Wire
Picker Tooth Wire
Pin Ticket Wire
Pin Wire
Ring Traveller Wire
Spiral Binding Wire
Stapling Wire
Stapling Wire for Preformed Staples
Stone Wire
Weaving Wire
Weaving Wire for Fly Screen Cloth
Wissco Iron Wire

HIGH CARBON FINE AND SPECIALTY WIRE
Aircraft Cord Wire
Armor Wire
Belt Hook Wire
Bobbin Ring Wire
Brush Wire (Tempered and Untempered)
Brush Wire (High Strain)
Chrome Vanadium Spring Wire
Core Wire (Aluminum Cable Steel Reinforced)
Curtain Spring Wire
Flexible Shaft Wire
"Gamma" Spring Wire (Upholstery Spring Wire)
Zig Zag Wire
No-Sag Wire
Hat Wire
Heddle Wire
Hose Reinforcement Wire
Hose Wire, Mechanical
Hose Wire, Vacuum and Defroster
Rope Wire
Signal Corps Wire
Spoke Wire
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MANUFACTURERS LOW CARBON COARSE WIRE
Bag Tie Wire
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Garment Hanger Wire
Hay Baling Wire (Coiled)
Lingo Wire
Lintel Wire
Loop Wire
Merchant Quality Wire
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Serving The Wire Industry Since 1940

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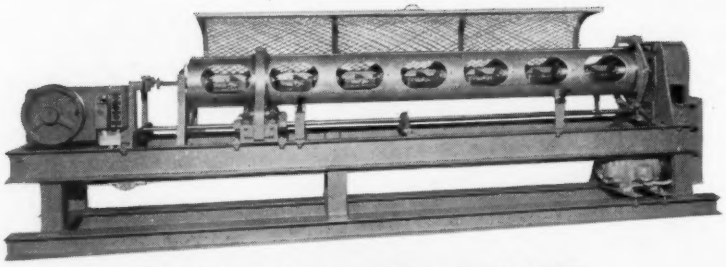
and
ENGINEERS



SEVEN BAY HI-SPEED STRANDER
MODEL 7B55

Bartell Machine Tool Corporation specializes in the design and manufacture of precision machine equipment to meet the exacting requirements of the wire industry as well as for the military. Serving the wire industry since 1940, typical equipment manufactured includes fine wire high-speed wire stranders—light, medium and heavy re-spoolers — take-ups — pay-offs — tinning take-ups — multiple head respooler — caterpillar capstans — extrusion mandrels.

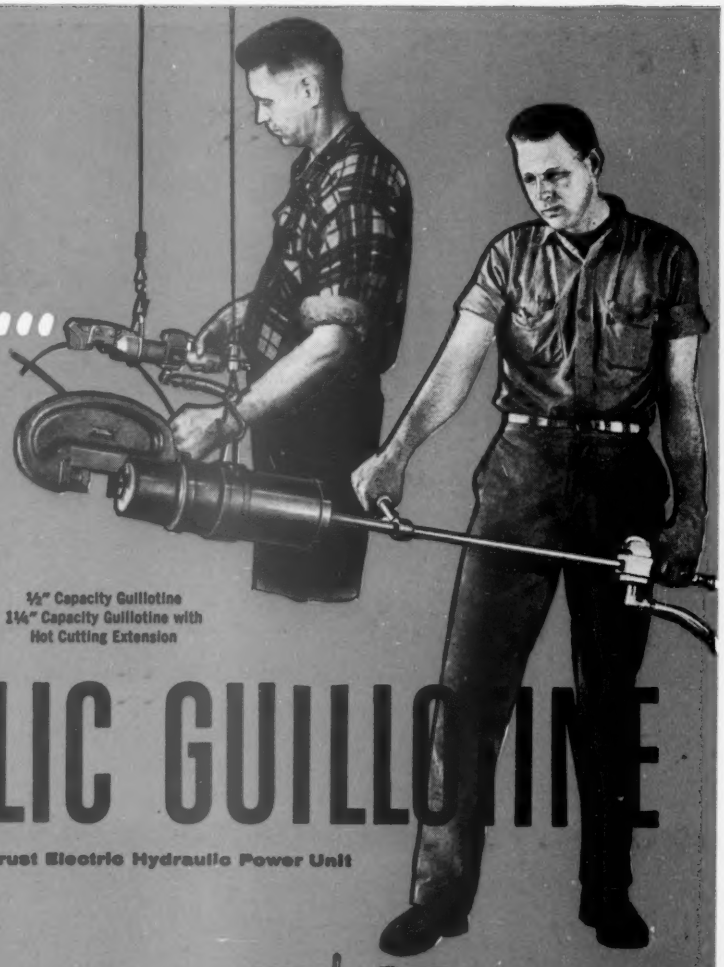
For further information write to . . .

BARTELL MACHINE-TOOL CORPORATION

ROME, NEW YORK

Fastest, Lowest Cost...

METHOD FOR CUTTING WIRE AND ROD



½" Capacity Guillotine
1¼" Capacity Guillotine with Hot Cutting Extension

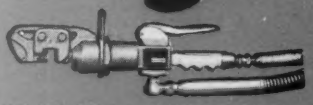
MANCO

HYDRAULIC GUILLOTINE

Powered by Manco Hi-Thrust Electric Hydraulic Power Unit

ENGINEERED FOR MINIMUM MAINTENANCE

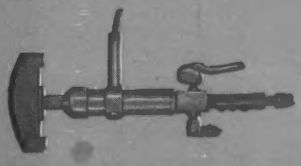
These are completely re-engineered and redesigned versions of the famous Manco Hydraulic Guillotines used by virtually all major rod mills throughout the world. These new units provide even greater performance . . . and require an absolute minimum of maintenance. It is also possible now to operate two cutter heads off one power unit, either by using the new Manco HA-2 Hi Thrust power unit, or by adding the new Manco Auto-Selector Valve to present Manco power units.



Model MC 210: Capacity ½". High speed . . . ¼ second per cut. Full swivel action.

Model MC 35: Capacity 1". Cuts high carbon material including reinforcing rod in only one second per cut.

Model MC 65: Capacity 1¼". Cuts 1¼" diameter steel in 2 seconds per cut. Can be modified to cut 1⅜" diameter aluminum.



MANCO HYDRAULIC ROD STRAIGHTENER

Ideal for straightening leading end of heavy coiled wire for insertion into drawing dies and cold heading machines. Capacity of ⅜" to 1¼" diameter steel rod.

WRITE FOR CATALOG

MANCO MFG. CO., Bradley, Illinois
Dept. No. W-10

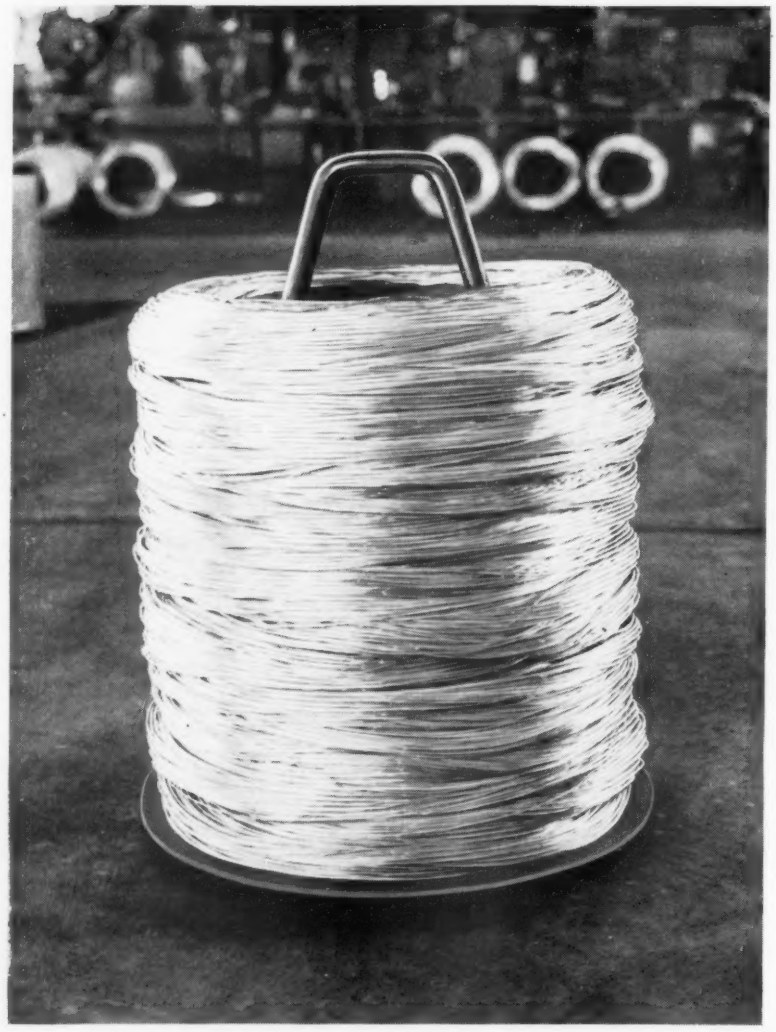
Please send:
Catalog of New Guillotine Wire and Rod Cutters, and Rod Straightener.

Name_____

Firm_____

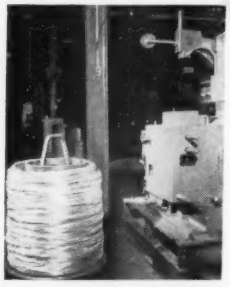
Street_____

City_____ Zone____ State_____



1 *Fork-lift truck easily lifts 'pay-off' rack and quickly transports it to and from machine.*

2 *Volco 'pay-off' racks easily stack into sturdy, space-saving stockpiles. No weight ever rests on the wire coils.*



3 *A man's work is practically done when machine is threaded with wire from unique, long-playing Volco 'pay-off' rack.*

VOLCO wire pay-off and storage rack

Patent Pending

CUTS "DOWN" TIME

Another Volco first . . . another example of our continuing efforts to provide a better product and streamline your operation . . . at no extra cost to you!

Now, Volco wire is supplied in one continuous coil and wound on a unique 'pay-off' and storage rack which is easily conveyed to your machines by any standard fork-lift truck or transporter. This 'pay-off' rack enables you to run many times the usual length of wire and, in turn, permits your machines to run longer on one set-up . . . reducing down time. Result: *lower operating costs, and higher production efficiency.*

The new Volco 'pay-off' racks pay off in more ways than one. They may be safely tiered by any fork lift truck to save you costly floor space.

Contact your Volco representative today for further information.

VOLCO BRASS AND COPPER CO

BRASS • COPPER • BRONZE • NICKEL SILVER : WIRE • ROD • STRIP • SHEET

Mills and Sales Office: Kenilworth, N. J., Chestnut 5-7200 • *New York Phone:* Worth 2-7500 • *Branches:* Chicago • Philadelphia • Cleveland • Providence • Hartford

JAEGER

WIRE WEAVING LOOMS

FOURDRINIER WIRE LOOMS and CLOTH STRETCHING MACHINES

SCREEN ASSEMBLING LOOMS

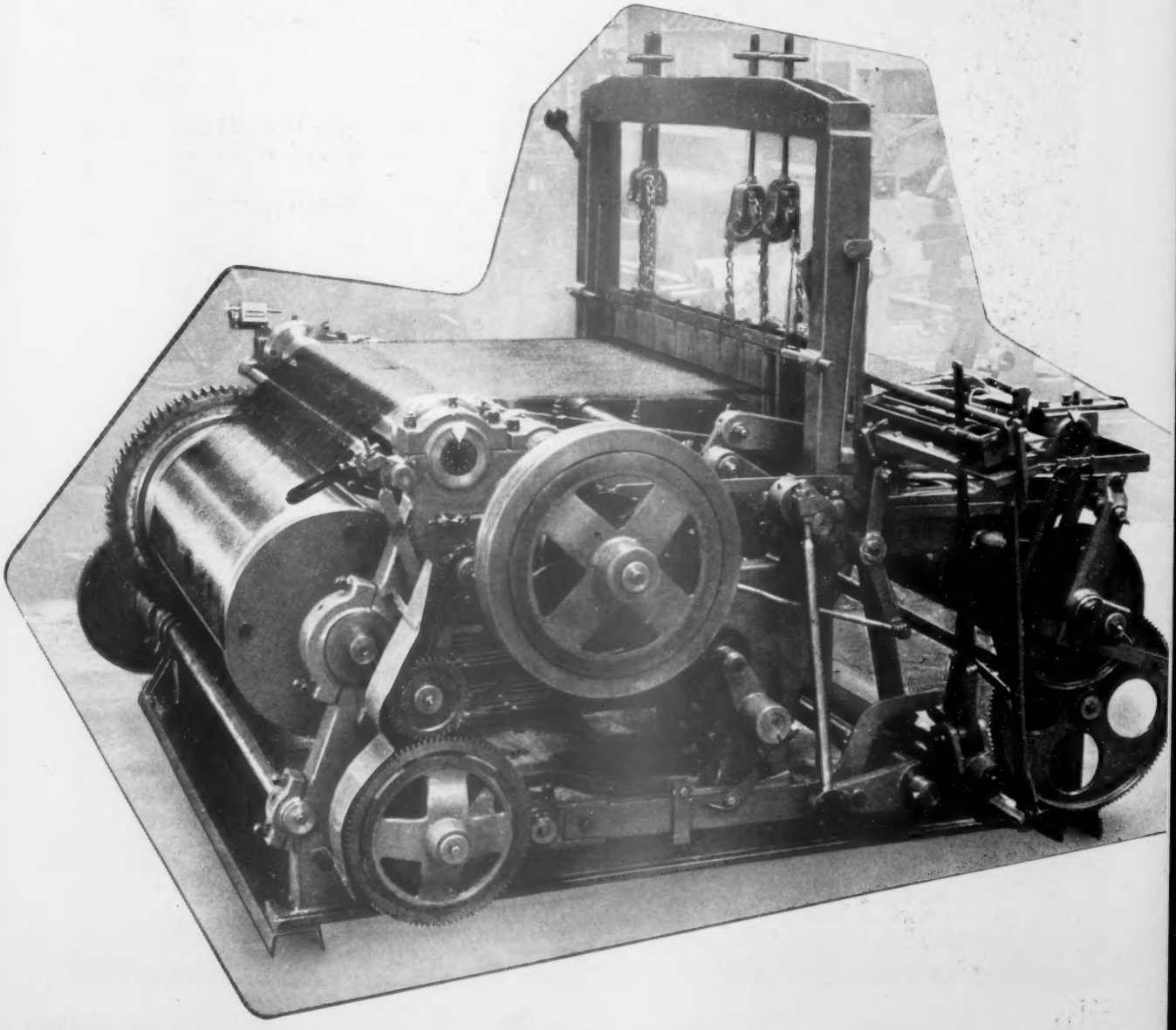
CRIMPING MACHINES

AUXILIARY MACHINES FOR WIRE WEAVING

Model DFM

Loom for very fine Mesh

for meshes 40-600 p. inch and wire from .00078" to .098"



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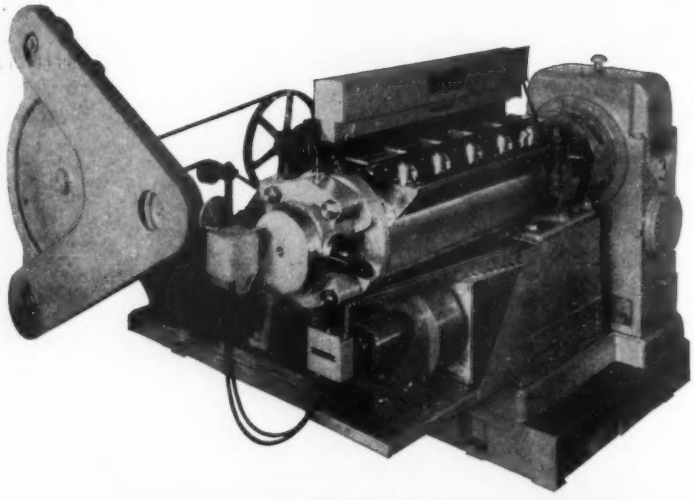
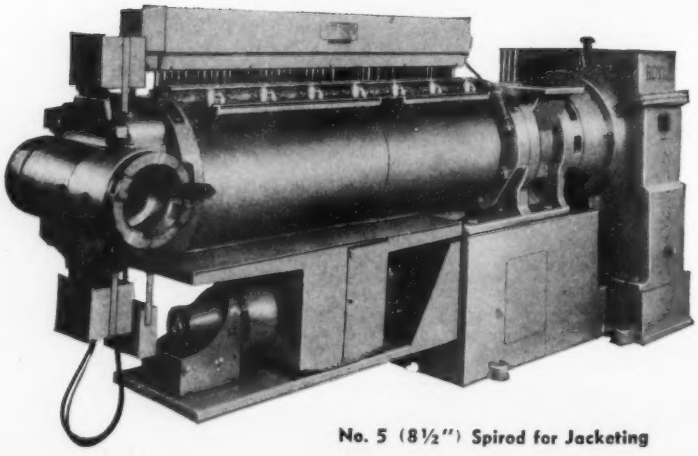
CEDAR-WEST TOOL CO. INC. • 88-90 WEST ST. NEW YORK 6, N. Y. • Tel. REctor 2-1530

ROYLE SPIROD®

FOR EVERY EXTRUSION PROCESS



No. 3 (4½") Spirod for Plastic Wire Insulation



No. 5 (8½") Spirod for Jacketing

■ The versatility of Royle Spirod extruders is the result of more than three-quarters of a century of keeping pace with the processing developments in the rubber and plastics industries. With its positive, zoned radiant heating and high velocity evaporative cooling Royle Spirod extruders are equally "at home" processing either rubber or plastic compounds.

- Complete Equipment for Room Temperature Continuous Vulcanizing
- Complete Equipment for Plastic Wire Insulating
- Strainers
- Cooling Troughs
- Light Wire and Cable Capstans
- Motorized Take-Ups
- Temperature Control Units
- Panel Boards
- Heads
- Insulating Fixtures and Supplies

JOHN ROYLE & SONS

ROYLE PATERSON N. J. 1880

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USED WIRE AND CABLE EQUIPMENT
STRANDERS
1 7-bay, 9½ x 5
1 7-bay, 11 x 6
1 19-bay, 6½ x 4½
1 7-bay, 6½ x 4½
2 7-bay, 5½ x 4
BRAIDERS
New England Butt No. 2's:
10 16 carrier
30 20 carrier
150 24 carrier
Wardwell:
10 24 carrier
Textile Machine Co. No. 2's:
25 20 carrier
30 24 carrier
30 24 carrier #3 large braiders
4 16 carrier #3 large braiders
BUNCHERS
Haskell-Dawes:
20 8 x 10
10 12 x 14
WIRE DRAWING MACHINES
2 16-die Elevator Supply Intermediates
15 Waterbury-Farrel, Tub Type
1 Waterbury-Farrel, Rod Breakdown
REELS
100 24 x 14 steel reels
50 24 x 6
150 22 x 11
MISCELLANEOUS
Terkelsen Paper Wrapping Machines
2 Laboratory Plastic Extruders
1 Royle #1 Electric Plastic Extruder with Wheelco Controls
5 Universal Winding Machine Co. Coil Winders
2 12-spool Takeup Stands, 24" reels
1 6-spool Takeup Stand, 22" reels
11 Sinfra Knitters, Model 3 CH
10 Pitch Tanks
1 Emory 6-Head Respooler
1 Rubber Mill, 12 x 17
1 National Rubber Combination Takeup Stand
1 Industrial Oven Dual Hydraulic Takeup Stand
1 Watson 28" Steel Taping Head
1 Sleeper-Hartley Armoring Machine
1 Syncro High-speed Single-spindle Serving Machine, complete with motors, for 24" reels, and takeup
1 6-bay, 7-wire upright planetary cabling machine, complete with jute attachments, serving head, with 24" capstan, takeup, motors, etc.
Kick and Power Presses—all sizes.
Many other items too numerous to mention in stock.
WE BUY . . . WE SELL
WE WOULD LIKE TO BID ON YOUR SURPLUS EQUIPMENT
WHEN YOU NEED WIRE EQUIPMENT, TRY US FIRST
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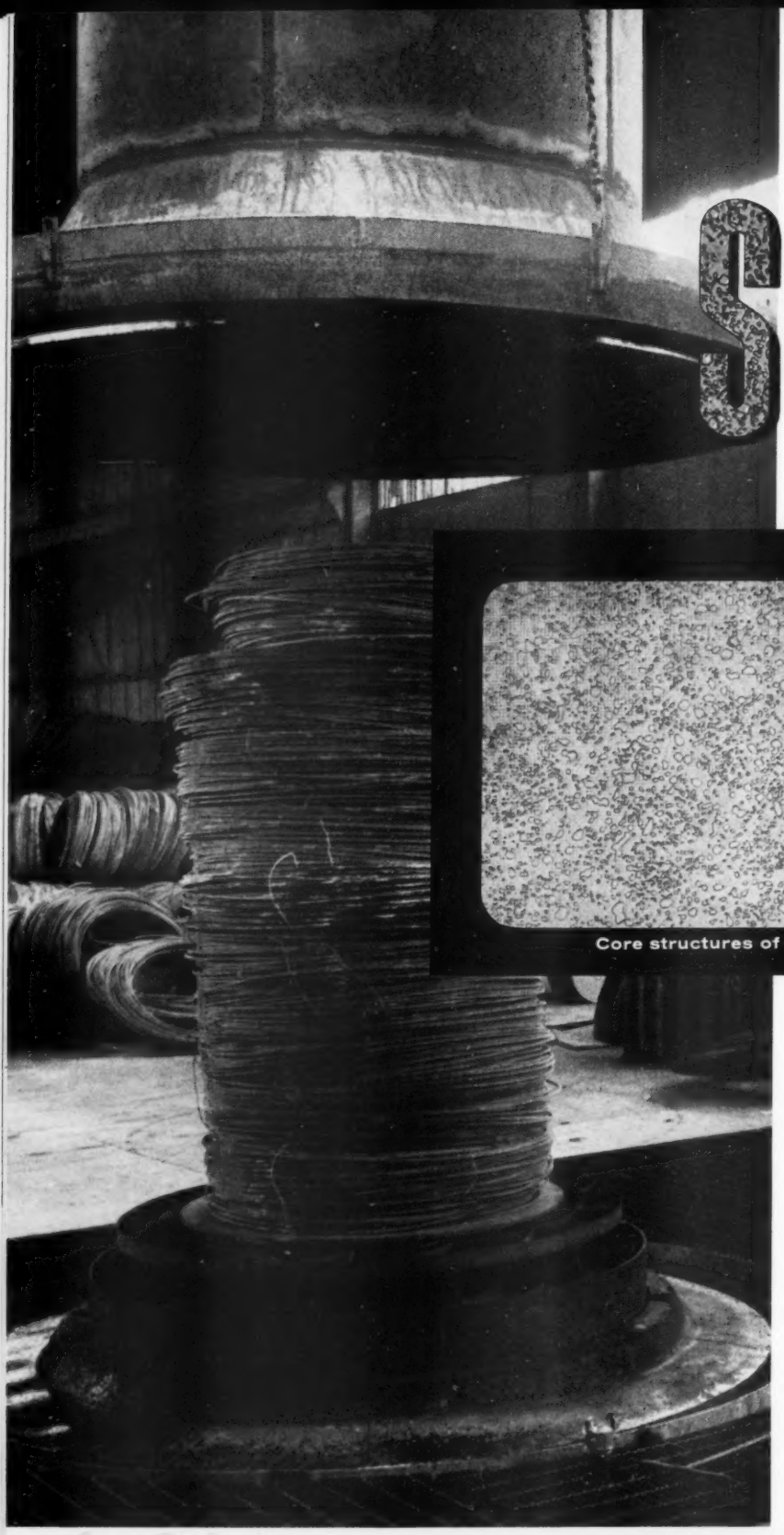
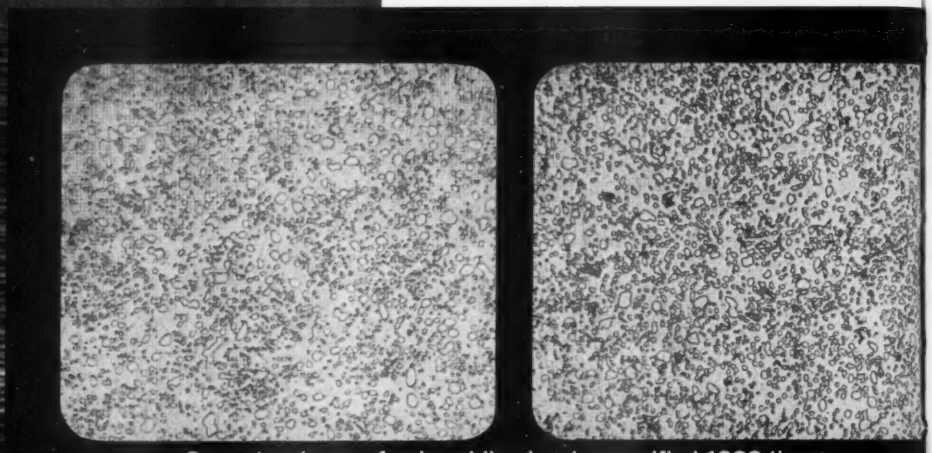


HERE'S Spheroidizing AT ITS FINEST...



Core structures of spheroidized rod, magnified 1000 times.

SPHEROIDIZING PROCESS MADE EASY WITH LEE WILSON HIGH CONVECTION FURNACES

Nothing rolls like a ball — this applies to bearings as well as the grain structure of steel which is to be formed cold into bolts, auto bumpers, lock washers or razor blades.

To get this spheroidal structure in steel, the metal must be uniformly heated, but in no part overheated, and, after all parts of the charge are at the temperature required, it must be uniformly cooled at controlled rates so that the iron-carbon grains will have the shape of a ball as they form.

This heat treatment of steel has enabled fabricators to eliminate slow and expensive hot forming processes and to cold form a multiplicity of items at almost unbelievable speeds.

The Lee Wilson High Convection Bell Type Annealing Furnace with uniform heat application, specialized cycle control, and gas circulation up to 25,000 cfm. under a sealed inner cover, was designed specifically to meet all the requirements for uniformity and closeness of control demanded by this process.

Lee Wilson* ENGINEERING COMPANY, INC.
20003 WEST LAKE ROAD • CLEVELAND 16, OHIO

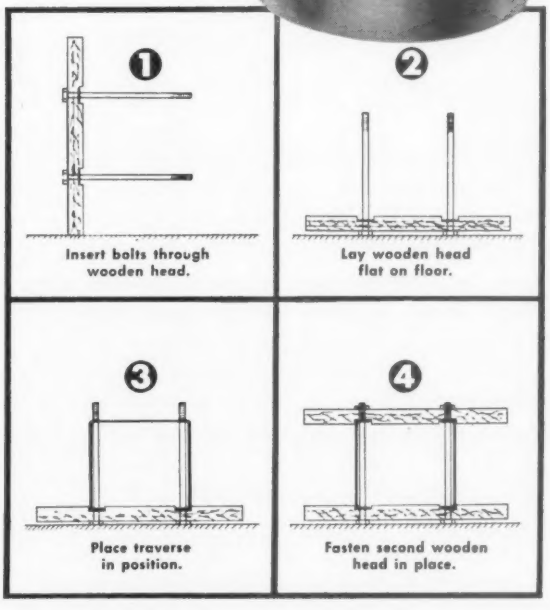
HIGH CONVECTION ANNEALING FURNACES
MAKE THE BEST METALS BETTER

*ORIGINATORS AND LEADING PRODUCERS OF HIGH CONVECTION ANNEALING FURNACES

Assemble it — Forget it

SAVE *Time Labor Money*

REPUBLIC FLANGED STEEL TRAVERSES



SAVE TIME...Simple 4-Step Reel Assembly

SAVE LABOR...No Special Tools, Lightweight Construction

SAVE MONEY...Long, Trouble-Free Service

SAVE SPACE...Stack and Store in a Minimum Area

Republic Steel Traverses are reinforced where it really counts—at flange base and bolt holes. Makes possible the use of lighter gage steel. Reduces unit weight 20%. You get the highest strength-to-weight ratio attainable.

Three different finishes—plain, painted, and hot dip galvanized—meet all cable requirements. Flange width and bolt and drain holes can be furnished to your specifications.

Choose from industry's most complete line. Over 100 sizes ranging from 12″ to 56″ diameters and 6″ to 48″ lengths. All available for quick delivery. The coupon below will bring complete information.

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World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL

REPUBLIC STEEL CORPORATION
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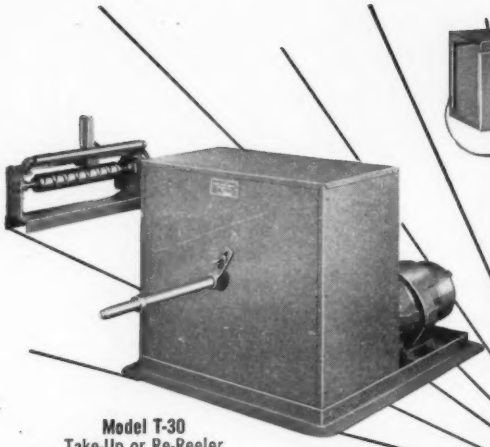
Send more information on Flanged Steel Traverses.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

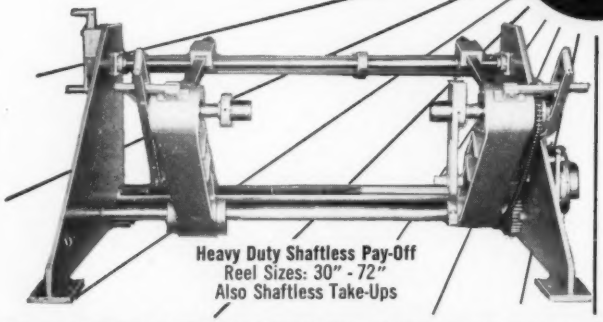


Model T-30
Take-Up or Re-Reeler

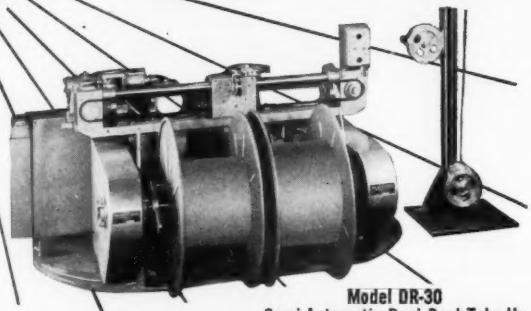
No. 4 Spark Tester
Automatic Resparking for Re-Reeling

CV Type Sparker
For Continuous Vulcanizing
or Plastic Extruding

FOR ACCURACY — DAVIS WIRE & CABLE EQUIPMENT — FOR DEPENDABILITY



Heavy Duty Shaftless Pay-Off
Reel Sizes: 30" - 72"
Also Shaftless Take-Ups



Model DR-30
Semi-Automatic Dual Reel Take-Up

THE NEWLY REDESIGNED *DAVIS WIRE & CABLE EQUIPMENT* IS BETTER THAN EVER

Modernized, streamlined and engineered for fast production of safely insulated wire and cable, the newly redesigned DAVIS ELECTRIC line of Spark Testers, Pay-Offs, Take-Ups, Counters, Spoolers, Traverses and Capstans is now offered as the finest ever conceived and produced by DAVIS ELECTRIC engineers. Before you buy, you owe it to your pocketbook as well as your business reputation to learn what this unexcelled machinery can do to better satisfy your customers (and your stockholders!). Refinements and advancement in designs qualify the 1957 DAVIS ELECTRIC line to surpass in performance previous DAVIS products in use in 80% of the industry's wire mills and some of which have been in operation for 15 years without maintenance problems!

What better tribute to quality can one ask?

Write for complete details and find out how DAVIS ELECTRIC can improve your wire and cable production and promote profit in your plant.

Davis ELECTRIC CO.

WALLINGFORD, CONN., U.S.A.

DAVIS WIRE & CABLE EQUIPMENT

HARNESS TESTERS ★ PAY-OFFS ★ TRAVERSES
SPARK TESTERS ★ SPOOLERS ★ TAKE-UPS ★ CAPSTANS

Correspondents throughout the world

Foreign Sales Representatives: OMNI PRODUCTS CORP. 460—4th Avenue, New York 16, New York

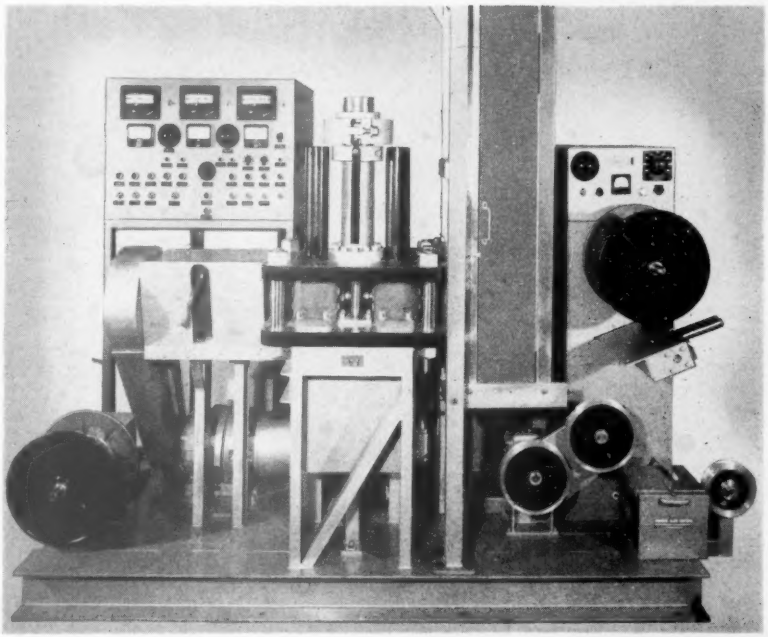
ANNOUNCING • • •

A NEW TEFLON* EXTRUDER

This completely new extruder for insulating wire with Teflon* resins is now in production and available

IT FEATURES:

- HIGHER PRODUCTION SPEEDS, PRODUCING QUALITY WIRE.
- MAINTENANCE AT A VERY MINIMUM.
- INTERCHANGEABLE CYLINDER FOR CHANGE FROM 1½" to 2½".
- ALL DRIVES ELECTRONICALLY CONTROLLED, WITH NEWLY DESIGNED ELECTRICALLY CONTROLLED TENSION PAY-OFF.
- STEPLESS RANGE OF HEATING IN OVENS BY USE OF REACTORS, OVENS REACHING OPERATING TEMPERATURE IN A FEW MINUTES.
- DOUBLE SCREW RAM TO PREVENT LEAKAGE OF NAPHTHA IN SCREW JACKS AND TO SUPPLY MORE POWER.
- GUIDE TIP ADJUSTMENT BY MEANS OF A ½" ROD TO ELIMINATE POSSIBLE BUCKLING OF THE TUBE.



There can be no lost motion, nor are extra steps necessary, since the Master Control Panel (see upper left in picture) is readily available to the operator for any adjustments that may be required during the extruding process.

The extruder is completely wired—just connect to the power supply and it is ready for operation. It is also equipped with a DAVIS Spark Tester to locate dielectric faults without breaking fine wire. This means that there will be NO necessity for re-stringing the wire.

Write for complete details or telephone for an appointment (COlony 9-3359) to see this Teflon* Extruder in operation.

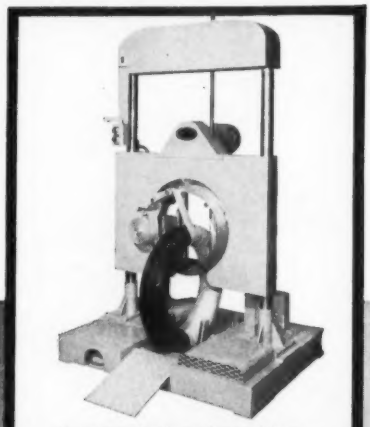
* Registered du Pont Trade Name.

DAVIS ELECTRIC CO.
WALLINGFORD, CONNECTICUT

DAVIS WIRE & CABLE EQUIPMENT

DUAL and SINGLE TAKE-UPS • PAY-OFFS • CAPSTANS
SPARK TESTERS • RE-SPOOLERS
RAM-TYPE TEFLON EXTRUDERS

How Ludlow Solves Your Spiralwrapping Problems



Custom-designed machines

Spiralwraps...plain or printed

Devices . . . for folding, edging and tension control

The packaging line moves fast when coils are wrapped with Ludlow spiralwrap papers *and* by Ludlow spiralwrap equipment. Ludlow papers are creped-to-stretch for strong, snug packaging that provides coil protection from production line to customer.

There's a Ludlow creped paper for every protective spiralwrapping need: regular and waxed kraft; standard asphaltic duplex and reinforced paper for heavy-duty packaging; VPI paper for anti-rust packaging; non-asphaltic neutral paper for non-corrosive packaging.

Ludlow spiralwrap machines are designed for speedy, dependable wrapping. They take coils of practically any diameter or weight and are equipped with tension and folding devices that mean real safety in spiralwrapping.

There's a Ludlow Factory Serviceman and Technical Representative in your area. He's available — without obligation — for fast, personalized service. Ask him to help solve *your* spiralwrapping problems.

Only Ludlow offers a complete spiralwrap service

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Packaging Papers Division

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NATIONAL WIRE

(COLD ROLLED)

in Coils or Straight Lengths

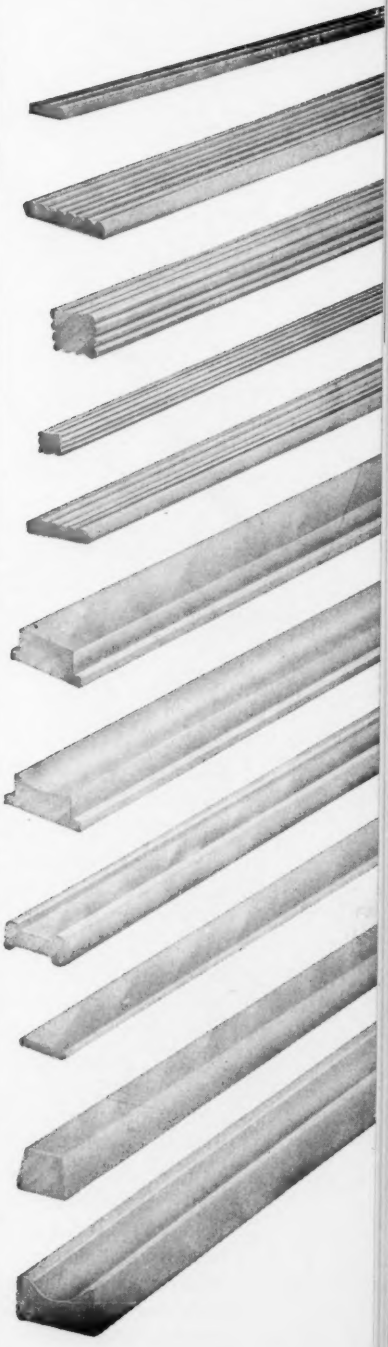
COMPLETE METALLURGICAL SERVICE

Manufacturers of

SPRING WASHERS	RETAINING RINGS
ROUND EDGE FLAT WIRE	KEYSTONE SHAPED WIRE
SQUARE EDGE FLAT WIRE	SPECIAL SHAPED WIRE

Shaped Wire in Coils or Straight Lengths, Ferrous or Non-Ferrous.

LARGE OR SMALL QUANTITIES



Manufactured by

THE NATIONAL LOCK WASHER COMPANY

PRECISION SHAPED WIRE DIVISION

NEWARK 5, N. J. MILWAUKEE 2, WIS. U.S.A.

With

NOPCO® KLY

a liquid fine wire drawing lubricant

Be sure to try Nopco KLY next time you're drawing fine size steel or fine and intermediate size copper wire. It's *different*—and everything different about it you'll find is a big advantage.

First, this emulsifiable oil mixes quickly and completely with water—hot or cold. This feature alone is enough to make it ace-high with you. But it has other advantages equally important.

Your bath lasts longer. Nopco KLY has a built-in affinity for water. Its lubricants stay *uniformly active* much longer, since the "drag out" of the lubricants from the solution is reduced beyond anything you've ever seen.

Prevents Formation of Insoluble Copper and Lime Soaps—both the copper soaps, which score dies, clog feed lines and screens; and the lime soaps you've been bothered with when drawing lime coated steel wire.

KLY may be used for high carbon, low carbon, limed, galvanized, and liquor finished fine steel wire—also for fine and intermediate copper, bronze, and brass wire. You'll surely want to try this die-saving, cost-saving lubricant soon. Write today for free booklet "Nopco KLY", which gives full instructions, lists percentages of fat in all emulsions.
Nopco Chemical Company,
Harrison, N. J.

YOU MIX IT FASTER, EASIER

YOUR BATH LASTS LONGER

YOU GET UNIFORMLY ACTIVE LUBRICATION

1907–1957 50 Years OF PROGRESS IN CHEMISTRY

NOPCO

PLANTS: Harrison, N. J.
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PLASTICS *Granulators* for the PREPARATION OF PLASTICS FOR EXTRUSION AND MILLING

Made by

ALSTEELE ENGINEERING WORKS, INC.

ARE ALL THAT THE NAME IMPLIES

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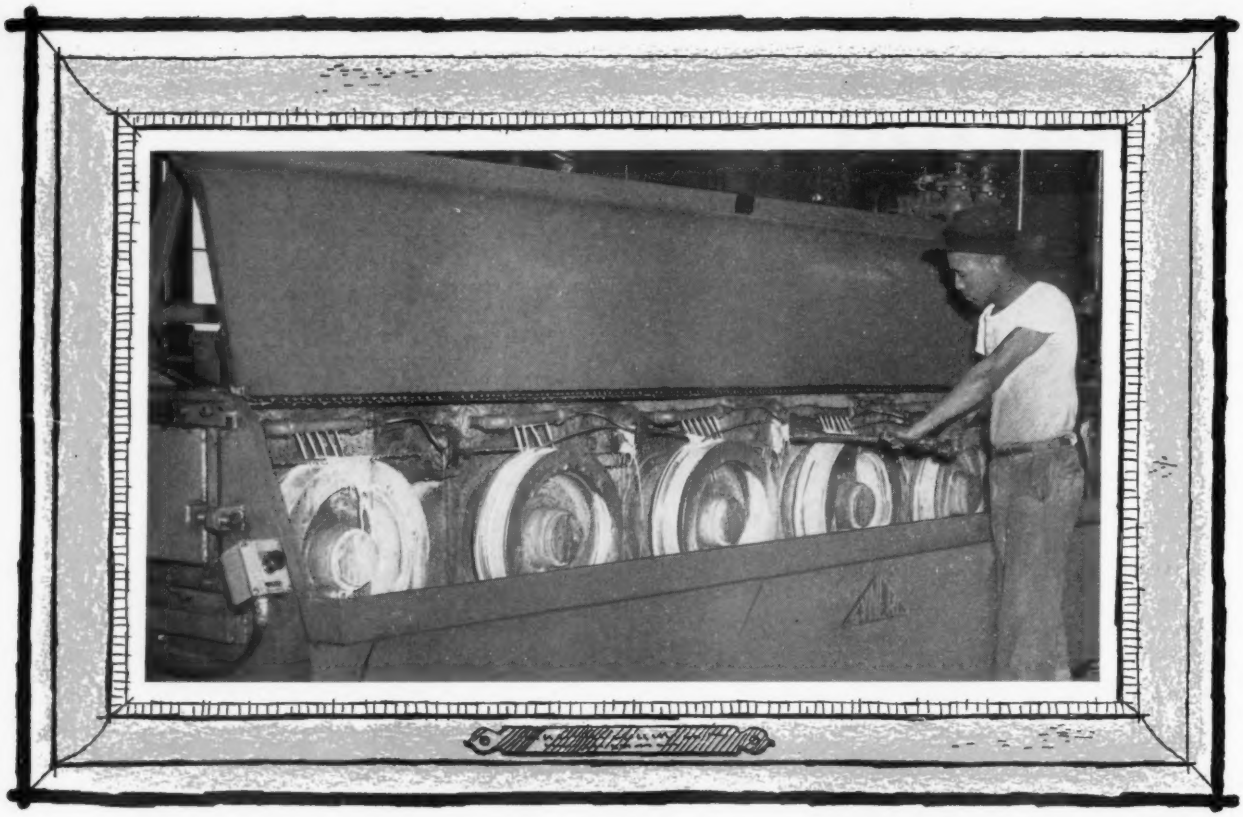
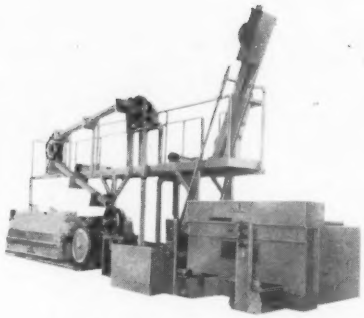
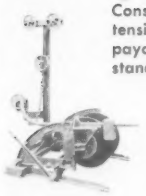
Specialists in the grinding and pelletizing of PLASTICS for THE WIRE AND CABLE INDUSTRY



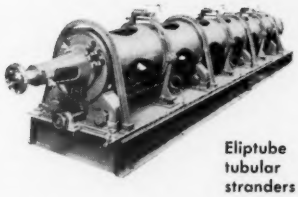
PRODUCTION . . .



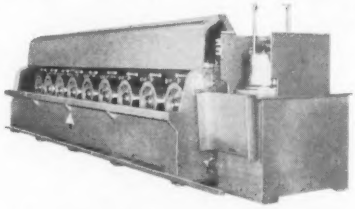
Combined drawing—
annealing and continuous spooling



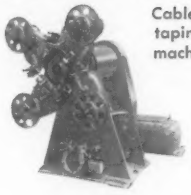
Constant
tension
payoff
stands



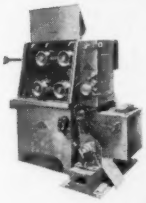
Eliptube
tubular
stranders



Tandem rod breakdown machines



Cable
taping
machines



Coarse and
fine wire
drawing
machines

. . . "PICTURED" AT IT'S BEST

TOP FLIGHT PRODUCTION **DEMANDS** TOP FLIGHT MACHINERY

Adopt SYNCRO . . . a complete line of quality wire and cable mill machinery of unparalleled design.
SYNCRO equipment is production-proved the world over. Engineering know-how and manufacturing skill are built into every SYNCRO machine. That is why you can expect and GET the very best when you specify SYNCRO equipment for your production line. Consult SYNCRO today for any of your wire and cable mill requirements.

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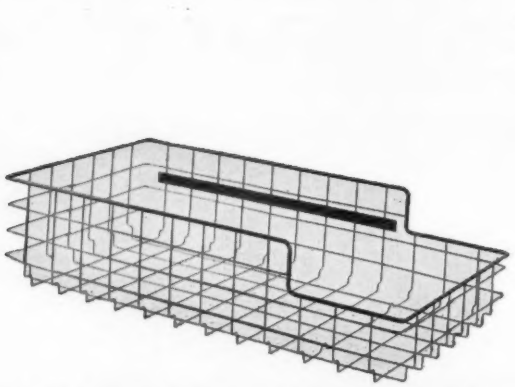
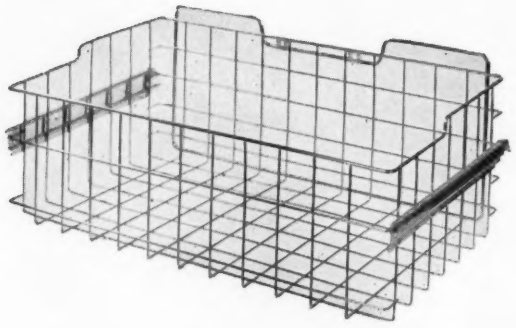
Better Machinery for the Wire Industry

SYNCRO®

WIRE DRAWING MACHINES • DIE STRINGERS • CONTINUOUS ELECTRIC ANNEALERS • PAYOFFS • CAPSTANS • WIRE INSULATORS • HEAVY DUTY TAKEUPS • TAPERS • SPECIAL MACHINE





YOUNGSTOWN EXTRA SMOOTH CLEAN BRIGHT BASIC WIRE

Plus Automated Fabrication Techniques Gives High Quality Production to *Bauer* Brothers

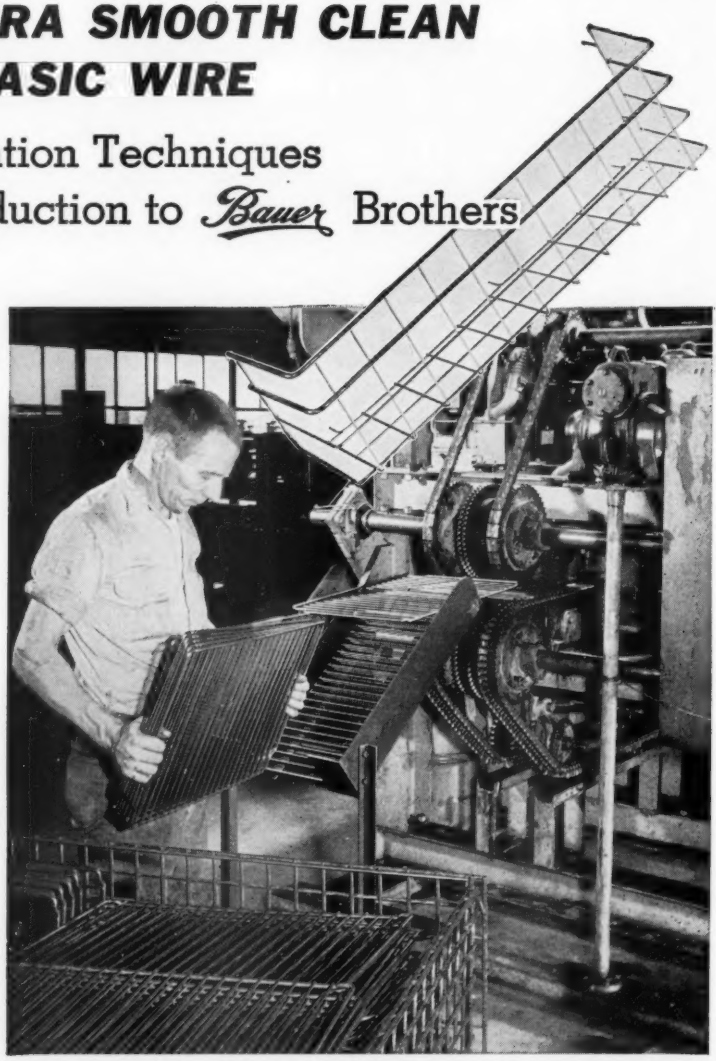
Over 75 years of production know-how combined with an excellent background of engineering experience enables the Bauer Brothers Co. of Springfield, Ohio, to provide their customers with economical, intelligent, up-to-the-minute wire product designs.

Using the latest techniques in "automation", this progressive fabricator relys on Youngstown's Extra Smooth Clean Bright Basic Industrial Quality Wire to keep both their production and product quality at a high level. They find it forms easily—while still providing the necessary rigidity and strength required in their finished products.

Its surface is free from all oil, dirt and grease which enables plating that's permanent—won't flake off. Also, it spot-welds fast and sure for permanent, strong construction. Why not make it your continuing specification for increased production and profits.

All Youngstown Wire is quality-controlled through each integrated operation from ore mining to final drawing. Thus, you can be sure there will be no injurious seams and piping, laps, die marks or internal tearing and cupping to hold up your production lines.

For additional information or metallurgical assistance, write or phone your nearest Youngstown District Sales Office today.



Bauer's "Flying Dutchman" using Youngstown Extra Smooth Clean Bright Basic Wire automatically fabricates a frame into a finished shelf in only 60 seconds.

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel
General Offices - Youngstown 1, Ohio
District Sales Offices in Principal Cities

Greetings . . . . . ALL MEMBERS

AND GUESTS OF **THE WIRE ASSOCIATION**

WE ARE PROUD OF THE COMPANY(S) WE KEEP (happy that is...)

KENNECOTT WIRE AND CABLE

UNITED STATES STEEL

MID-STATES STEEL AND WIRE

KAISER ALUMINUM

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BRODERICK AND BASCOM ROPE COMPANY

STEEL COMPANY OF CANADA

SIMPLEX WIRE AND CABLE

LACLEDE STEEL

BETHLEHEM STEEL

B. GREENING WIRE COMPANY

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NEHRING ELECTRICAL WORKS

B. F. GOODRICH COMPANY

COPPERWELD STEEL

AMERICAN CHAIN AND CABLE

. . . AND MANY OTHERS

Our roster of distinguished users of Micro-Welders reads like the Blue Book of American Industry.

Ask THE FIRMS WHO USE MICRO-WELDERS

. . . for continuous butt welding of ferrous wire, sizes .005″ to 1.250″

. . . for continuous butt welding of non-ferrous wire, sizes .010″ through 1.000″. . .

They will tell you that Micro-Welders are

- **Easy to Operate**
- **Durable**
- **Economical**

MICROMETER PRECISION — MICRO-WELD — TRADE MARK REGISTERED

OUR 30 YEARS OF EXPERIENCE IN THIS HIGHLY SPECIALIZED FIELD ARE AT YOUR COMMAND . . .

CALL OR WRITE

MICRO PRODUCTS CO.

Charter Member of The Wire Association

MODEL S.E.M.T.
For Welding All Types of Fine Wire Aluminum, Copper, Brass, Bronze, Steel and Steel Alloys, sizes .005″ to .020″

Model S. E. M. T. is equipped with a temperature-indicating device for annealing and tempering, voltage regulator and meter to compensate for voltage fluctuations, wire cutters, extra large magnifying glass, fluorescent light and extension cord. Can be supplied for bench-mounting or mounted on 4-wheel truck.

Model A. C. M. T., similar in design, covers capacities from .010″ to .062″.

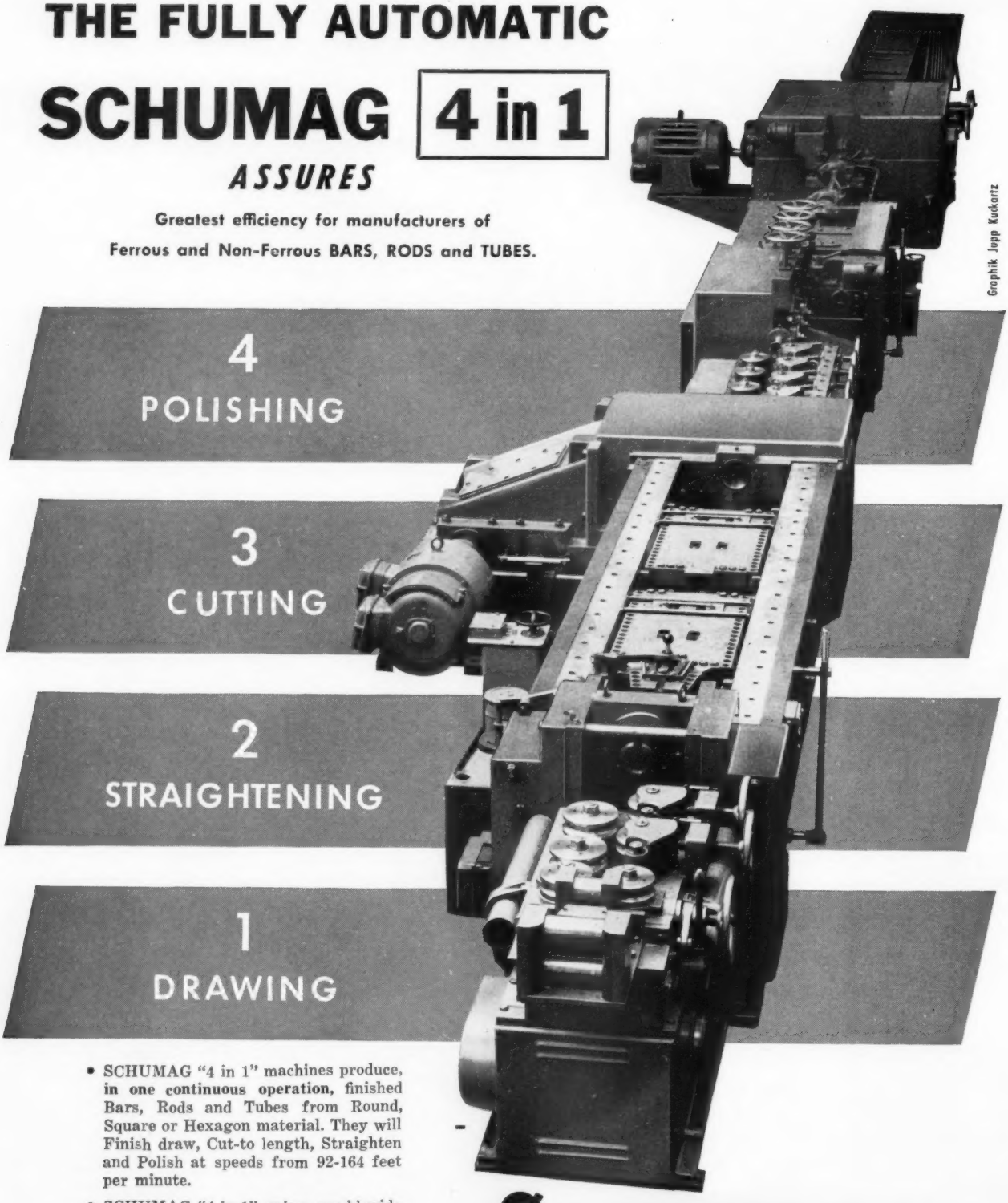
20 NO. WACKER DRIVE
CHICAGO 6, ILLINOIS
TELEPHONE STate 2-7468

THE FULLY AUTOMATIC

SCHUMAG 4 in 1

ASSURES

Greatest efficiency for manufacturers of
Ferrous and Non-Ferrous BARS, RODS and TUBES.



Graphik Jupp Kuckartz

- SCHUMAG "4 in 1" machines produce, **in one continuous operation,** finished Bars, Rods and Tubes from Round, Square or Hexagon material. They will Finish draw, Cut-to length, Straighten and Polish at speeds from 92-164 feet per minute.
- SCHUMAG "4 in 1" enjoys world-wide reputation as the **ultimate** in technical development.

SCHUMAG
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Exclusive Representatives for USA, Canada & Mexico
AMERICAN LAUBSCHER CORPORATION Fisk Bldg., 250 West 57th Street, New York 19, N. Y.

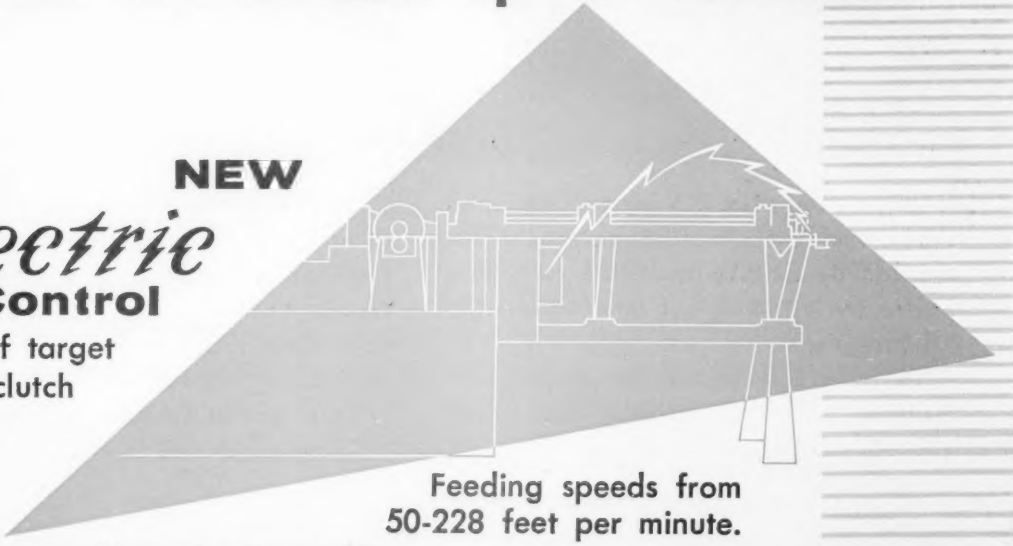
SOLVE all your wire straightening and cutting problems with

LOW COST!
EFFICIENT!
ACCURATE!
Capacity .025 to 11/16" diameter wire.

SHUSTER

Constant and Variable speed machines

NEW
Electric
Control
of target
and clutch



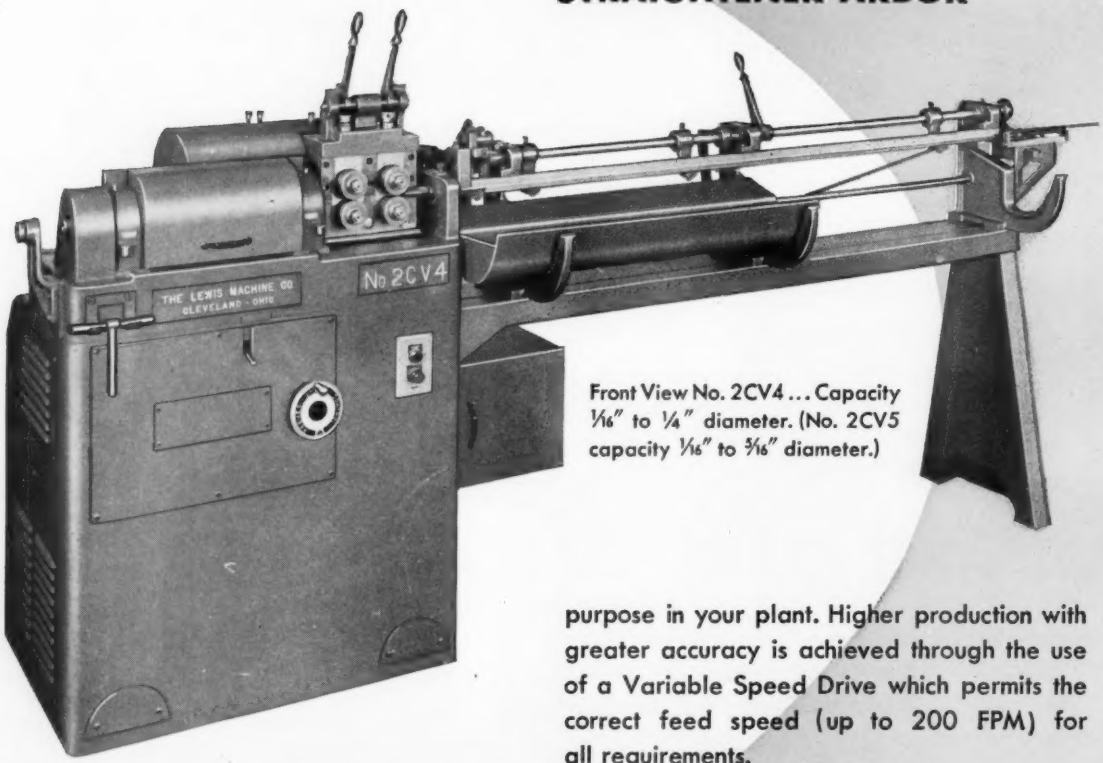
Feeding speeds from
50-228 feet per minute.

Send for free, wall-size split gauge Wire Chart from 41 gauge to 7/0.

METTLER MACHINE TOOL, INC.
155 West Adeline Street, New Haven, Conn.
Representatives in all principal cities.

THE NEW **LEWIS** *Convertible*

AUTOMATIC WIRE STRAIGHTENING AND CUTTING MACHINES WITH VARIABLE SPEED DRIVE AND DUAL-CENTER STRAIGHTENER ARBOR



Front View No. 2CV4 ... Capacity 1/16" to 1/4" diameter. (No. 2CV5 capacity 1/16" to 5/16" diameter.)

✻ The new Lewis No. 2CV series is equipped with our Dual-Center Rotary Straightener Arbor and can be quickly converted to handle shapes by installing our interchangeable Roll Straightener.

This convertible feature introduces a new flexibility in wire straightening and cutting operations . . . one machine can serve a double purpose in your plant. Higher production with greater accuracy is achieved through the use of a Variable Speed Drive which permits the correct feed speed (up to 200 FPM) for all requirements.

The outstanding feature of this series is the DUAL-CENTER STRAIGHTENER ARBOR (Pat. Pending) for round wire. This feature increases the range of the machine and makes it possible to precision straighten small diameters below the capacity of other machines.

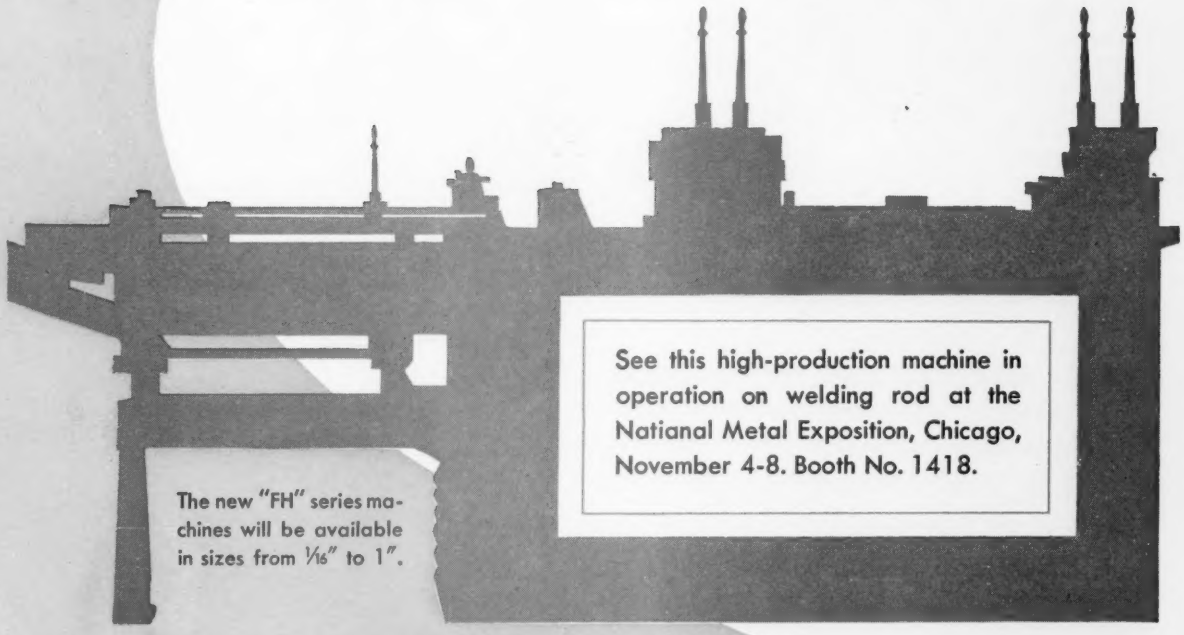
Other models available to handle .012" to 1" diameter, as well as shapes.

THE LEWIS MACHINE COMPANY

3441 East 76th Street • Cleveland 27, Ohio • A Division of Curtis Mfg. Co.

ANOTHER **LEWIS** *Achievement*

THE TERRIFIC NEW NO. 4FH WIRE STRAIGHTENING MACHINE WITH THE SENSATIONAL *NEW* HIGH-SPEED TRAVELING CUT-OFF



The new "FH" series machines will be available in sizes from 1/16" to 1".

See this high-production machine in operation on welding rod at the National Metal Exposition, Chicago, November 4-8. Booth No. 1418.

For many years the Lewis Travel-Cut has been the "Standard of the Industry" in wire straightening and cutting machines.

Now, a new principle of shear operation makes possible much higher production with feed speeds up to 300 ft. per minute.

Through simplified design a smooth, positive-action, high-speed shear actuating mechanism is attained without the use of loose links, cams or springs.

This new cut-off in conjunction with an air clutch and a variable speed drive, permits perfect synchronization with the wire at all feed speeds.

See Both Machines No. 2CV4 and No. 4FH at the Metal Show

THE LEWIS MACHINE COMPANY

3441 East 76th Street • Cleveland 27, Ohio • A Division of Curtis Mfg. Co.

WATERBURY FARREL
FOUNDED 1851

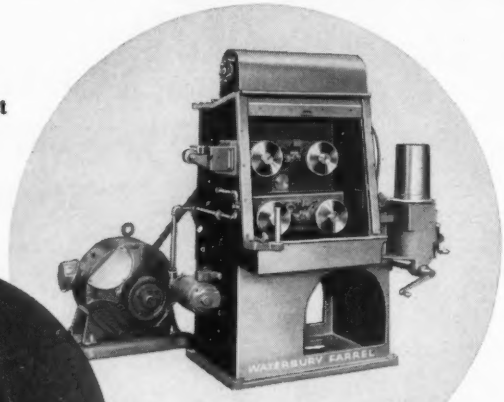
Custom-Engineered Upright Cone *Wire Drawing Machines*

★ **In 4 Sizes**

★ **With Drive, String-Up and Packaging Equipment To Fit *Your* Specific Requirements**

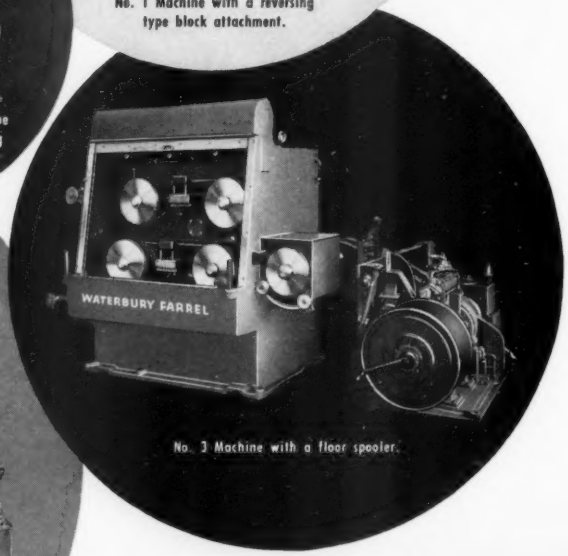
★ **And Precision, Quality Construction Throughout**

Here are four examples of Waterbury Farrel's long-proven ability to custom-engineer wire drawing machines for specific applications. The machine *you* need may call for another variation in design. For further information on the size and type of upright cone machine fitted to *your* exact requirements, contact Waterbury Farrel, today.



No. 1 Machine with a reversing type block attachment.

No. 2 Machine with a reversing type block attachment, adjustable finishing die and hand operated string-up.



No. 3 Machine with a floor spooler.

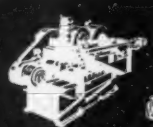
No. 4 Machine equipped with a cradle type floor spooler.

SPECIFICATIONS

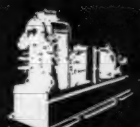
Size of Machine	No. 1	No. 2	No. 3	No. 4
Max. No. of Dies	16	14	12	13
Max. Starting Size B & S	#14	#8	#4	¼
Finishing Sizes, B & S	#26 to #42	#20 to #34	#14 to #26	#12 to #18

WF-26

WATERBURY FARREL
FOUNDRY & MACHINE CO.
Waterbury, Conn. U. S. A.
Sales Offices: Chicago • Cleveland • Millburn, N. J.


Bolt, Nut & Screw Machinery

Power Presses


Rolling Mill Machinery

Sendzimir Mills & Other Special Machinery

Wire Mill Equipment

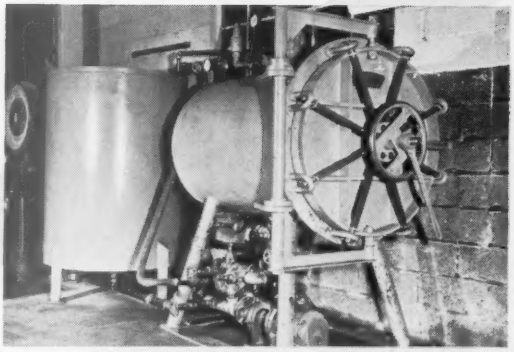
Hercules Filters

MAKE DIAMOND DIES LAST LONGER

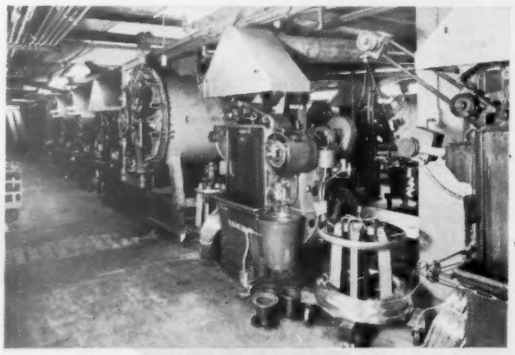
Oil, when used to spray dies and rollers, accumulates flakes of metal or other impurities, costs are increased and production is reduced. In the case of wire drawing, this will cause tungsten-carbide and diamond die wear which means replacement of the expensive dies.

When you install a Hercules filter in the wire drawing department, where oil is sprayed continuously to keep wire drawing dies cool, clean, and lubricated, there will be no impure oil to cause bearing roll wear. The finish and cleanliness of the product are not adversely affected.

Get the full facts, write for copies of Hercules "Fact Finder" with stories of the Wilbur B. Driver Company, New York Wire Cloth Company and other installations. Also, be sure to write in for the 4 page paper on the "Filtration of Lubricants for Aluminum Wire Drawing", containing the speech Mr. H. T. Jones delivered a short time ago as part of the Symposium on Aluminum Wire at the New York Regional Meeting of the Wire Association in New York City.



A Hercules Pressure Leaf Filter installation (Model #20—200 sq. feet area shown) filtering lubrication oil in connection with Sendzimir strip rolling mill.

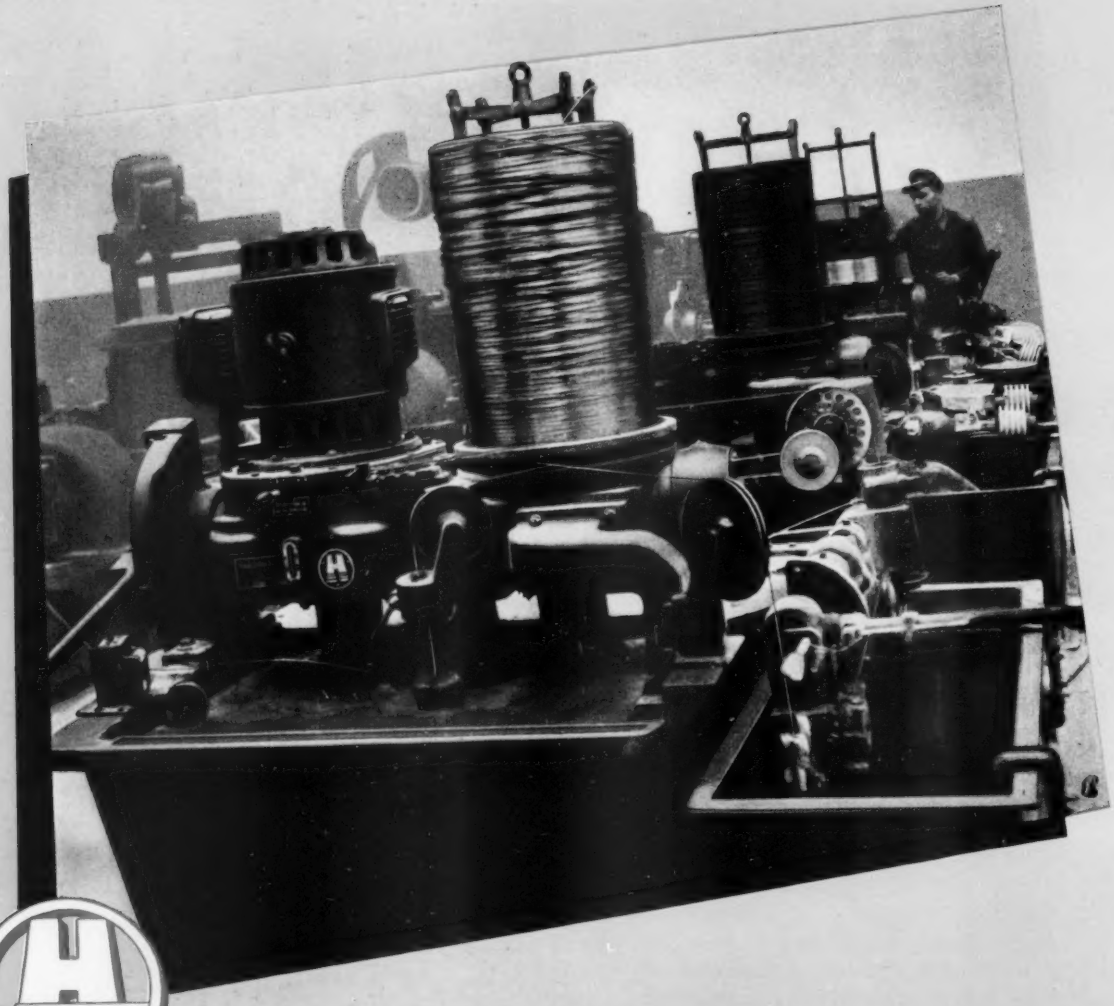


A Hercules Pressure Leaf Model No. 60 filter with 22 leaves (400 sq. ft.) together with some Vaughn CF-1 Ringblox wire drawing machine, oil for which it keeps pure and free from particles of metal and other foreign matter.

HERCULES FILTER CORPORATION

191 ETHYL AVENUE HAWTHORNE, NEW JERSEY

Only one rotating drawing block



TO WATCH ON HERBORN HIGH PRODUCTION MULTI-DRAFT WIRE DRAWING MACHINES OPERATING UNDER THE SUBMERGED SYSTEM

THE OPERATION OF SEVERAL MACHINES BY **ONE MAN** IS CONSIDERABLY FACILITATED BY THIS FEATURE.

The operation of these machines is as simple as A, B, C:

A)

The machine in string-up position. Note how easily and comfortably all working parts of the machine (dies, drawing rings etc.) are accessible to the operator.

B)

The machine being tilted into the drawing solution. Note how carefully the machine is balanced so that it will swing on its mainshaft with practically no effort at all on the part of the operator.

C)

The machine locked into drawing position, ready to operate.

These machines are suitable for the economic production of

Iron Wire,
Steel Wire,
Copper Wire.

Your inquiries are invited.

MASCHINENFABRIK HERBORN BERKENHOFF & DREBES A.-G. **HERBORN/DILLKREIS**

Sole Representative in the U. S. A.: GERMANY

KURT ORBAN CO., Inc. 34 Exchange Place, JERSEY CITY 2, N. J.

TERKELSEN'S
WRAPPING MACHINE

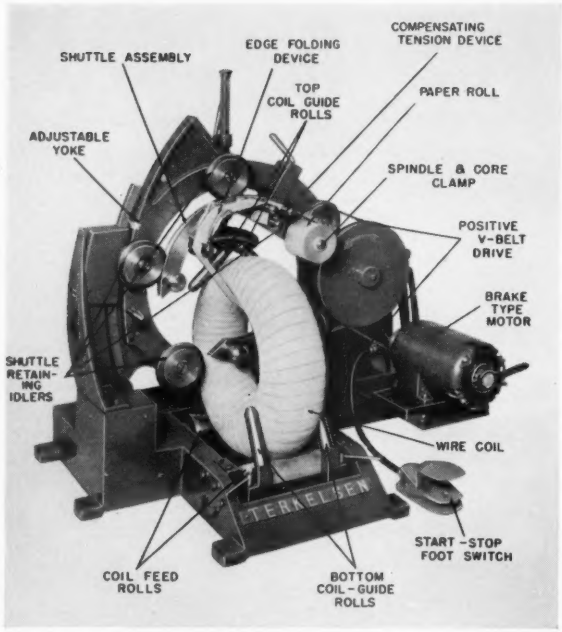
Designed to Wrap a Wide Range of Coils

MODEL 4-57

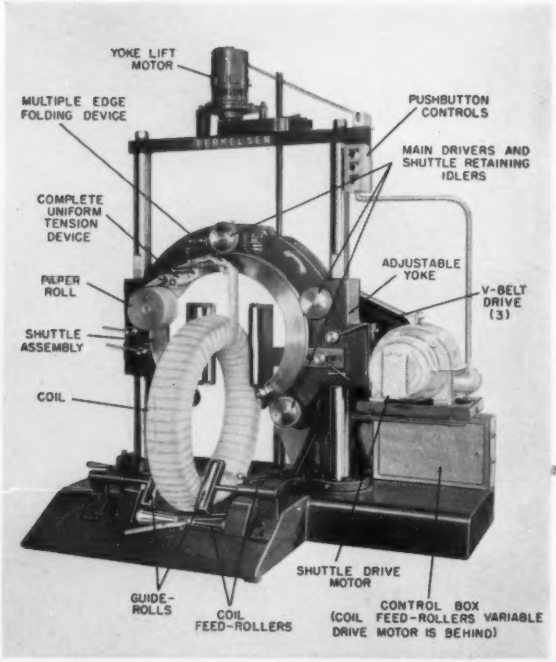
Terkelsen's newest wrapping machine wraps wire coils 17″ to 30″ outside diameter, minimum inside diameter of 10″, and with a cross-sectional diameter of up to 10″. New Model 4-57 features:

- **POSITIVE V-BELT DRIVE**
- **BALL BEARINGS THROUGHOUT**
- **START-STOP FOOT SWITCH**
- **COMPENSATING TENSION DEVICE**
- **EDGE FOLDING DEVICE**

Larger coil capacities available on order. Write for additional information.



TIGHT, UNIFORM WRAP OF STRAIGHT LENGTHS
HIGH SPEED PRODUCTION — UNEQUALLED BY ANY MACHINE



MODEL 4-B

Model 4-B has been designed to wrap a wide range of coils from 30″ to 50″ outside diameter with a cross-sectional diameter of up to 15″. Model 4-B features:

- **PUSH BUTTON CONTROL** *rotates coil in either direction.*
- **VARIABLE SPEED FEED ROLL DRIVE** *to obtain any desired overlap.*
- **POSITIVE V-BELT DRIVE** *from brake motor.*

For additional information on coil or straight length wrapping machines, write to:

TERKELSEN *Machine Company*

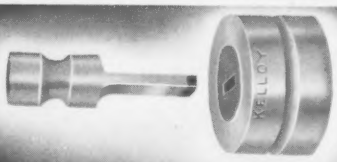
Terkelsen Building — 326 A Street Boston 10, Massachusetts
World's Largest Manufacturer of Spiral Wrapping Machines
Member WAS

FOR PRECISION AND ACCURACY

Specify "KELLOY" CARBIDE SHAPE DIES

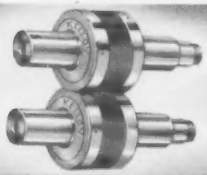
WEAR RESISTANT PARTS. BUSHINGS, GUIDES, CRIMPING, EDGING AND COATING DIES, etc.

CAPSTAN RINGS FOR WIRE DRAWING OPERATIONS. FOR EYELETS & DEEP DRAWN PARTS. ANY SHAPES.

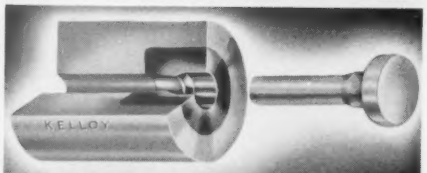


FOR COMPACTING POWDERED MATERIALS — SIMPLE AND COMPLEX SHAPES.

FOR SPRING FORMING. ALL TYPES OF SPRING TOOLING.

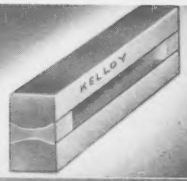


WIRE FLATTENING ROLLS. TRUE SURFACE FOR HIGH QUALITY FLAT WIRE.



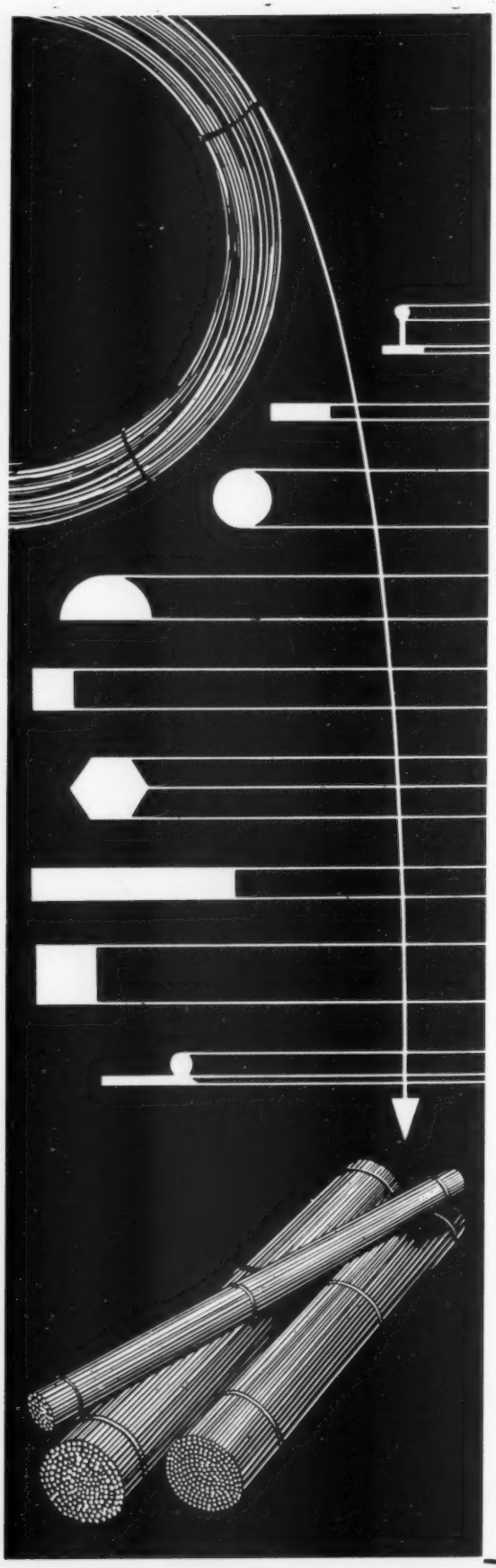
BOLT SIZING DIES. COMPLETE AND READY TO USE. CLOSE TOLERANCES.

SHAPE DIES WITH SHARP TRUE CORNERS FOR ACCURATE PRODUCTION.



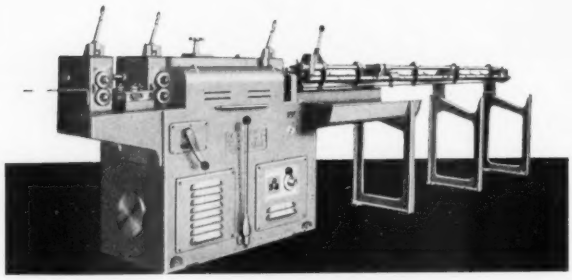
SIDE AND END BLOCKS. COLLAPSIBLE DIES FOR DRAWING BAR STOCK.

KELLOY CORPORATION
17 WEST 34th. STREET NEW YORK 1, N. Y.



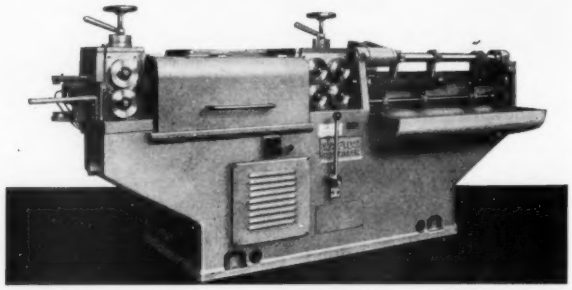
WAFIOS

WIRE STRAIGHTENING AND CUTTING-OFF MACHINES WITH STATIONARY SHEAR Models "DR", in 5 different sizes.



Production Range:
Wire diameter: .032" — .630"
Wire feed: 260 feet/min.
Standard straightening lengths up to 39'5"
Additional lengths can be provided if required

STRAIGHTENING AND CUTTING-OFF MACHINES FOR ELECTRODES Models "SDR", in 2 different sizes



Production Range:
Wire Gauge approx. .079" — .276"
Cutting lengths approx. 8" — 3' 3"
Output: up to 250 electrodes per minute according to cutting length and wire gauge

In addition, we build the following Straightening Machines:
Wire Straightening and Cutting-off Machines with flying shear
Wire Straightening and Cutting-off Machines for Profile Wire
Rolled Wire Straightening and Cutting-off Machines

WAFIOS MASCHINENFABRIK

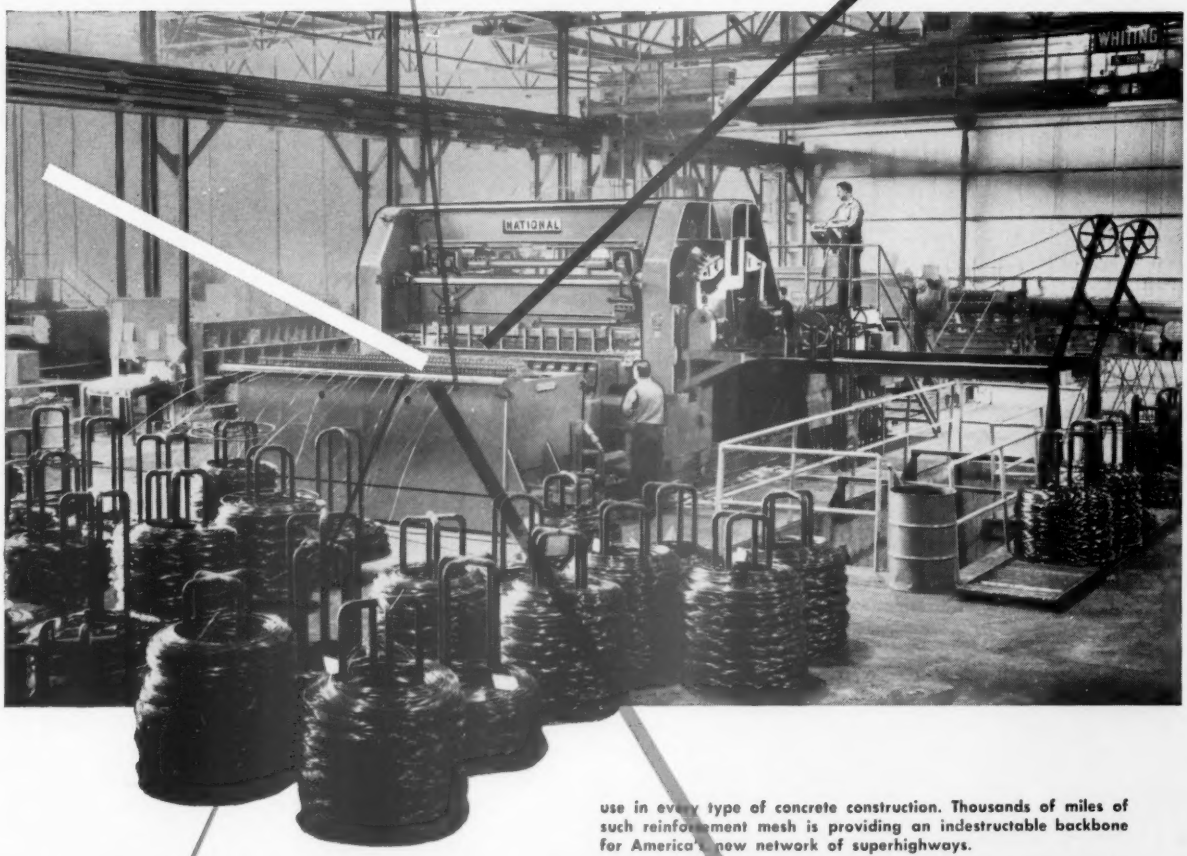
WAGNER, FICKER & SCHMID • REUTLINGEN/GERMANY

Represented in the U.S.A. by

KURT ORBAN CO., INC.

34 Exchange Place
Jersey City 2, New Jersey

this NATIONAL ELECTRIC UNIT is a completely automatic high speed wire mesh manufacturing plant



Starting with coils of line-wire, this National Electric Wire Fabric Welder automatically turns out welded wire mesh in a variety of sizes . . . and at surprising speeds. In a single hour, as much as 250 miles of wire is transformed into high-quality wire mesh for all kinds of uses including reinforcement in concrete construction, fencing, etc.

Beginning at a line wire straightener unit, each wire is passed over as many as 10 grooved, staggered rollers for straightening.

Next, the line wires pass over welding dies within the machine's welding unit. Here, under a pressure of 60,000 lbs., a mat as wide as 200" is welded at each junction-point, the cross-wires being fed in automatically, at whatever spacing may be indicated by the reciprocating indexing-platen.

The machine next shears rectangular mats to the required size or winds welded fabric into coils of desired length. Finished coils are automatically discharged onto a ramp . . . rolling away to the loading dock or warehouse.

The rugged, steel-mill design and construction of this machine makes it possible to efficiently weld as many as 120 cross-wires per minute. Since 1945, National Electric Wire Fabric Welders have been dependably turning out welded wire mesh in numerous sizes, for use in every type of concrete construction. Thousands of miles of such reinforcement mesh is providing an indestructable backbone for America's new network of superhighways.

Complete automation, the key to profitable production, is made possible in National Electric Welding machines by means of utilizing automatic feeds, dial feeds, automatic positioners, multi-head design, automatic discharge devices, motor-driven rotating fixtures and sequenced ejectors. By their speed and accuracy, National Electric machines achieve amazing savings in time, labor, and cost-per-weld.

Write today for complete information on National Electric Automatic Wire Mesh Welders or any other special or standard welding problem that you may have.

50

NATIONAL

ELECTRIC WELDING MACHINES CO.

1880 N. TRUMBULL STREET
BAY CITY, MICHIGAN

25 YEARS EXPERIENCE DESIGNING AND BUILDING: SPECIAL & STANDARD • AIR • HYDRAULIC • MOTOR DRIVEN • SPOT • PROJECTION • SEAM • BUTT • FLASH • RESISTANCE WELDERS • PRODUCTION FIXTURES FOR ALL TYPES OF AUTOMATIC ARC WELDING.

Precision

WIRE MACHINERY

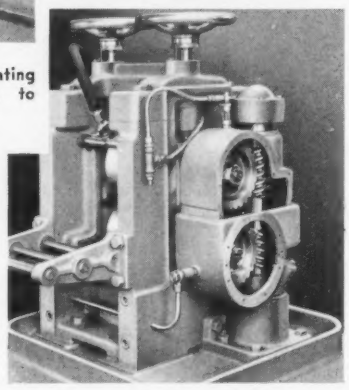
THE MODEL 26 WD WORM DRIVE PRECISION WIRE FLATTENING MILL

Worm and Worm-wheel drive to Roll Shafts; Automatic Lubrication to all Bearings; Rolls 6" dia. x 4" wide, hardened to 64-65 Rockwell Scale C; Internal and/or external water cooling to Rolls.

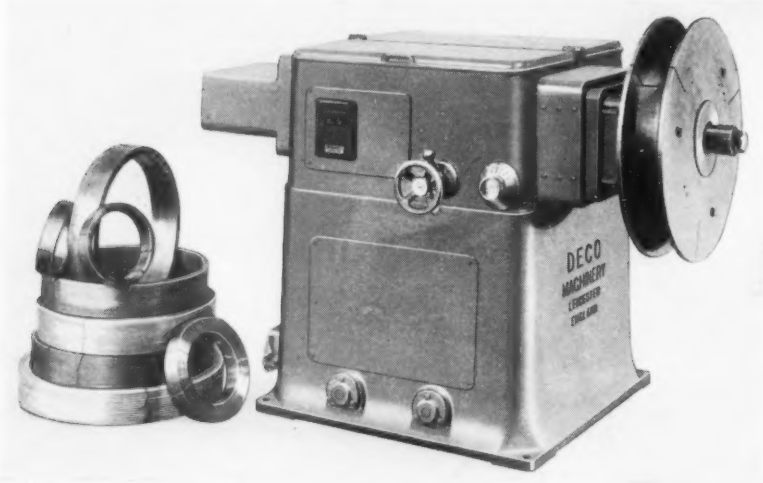
PERFORMANCE at 250 feet per minute

NON FERROUS.	.267" Copper to .125" in four passes.
	.104" Gilded Metal to .042" in one pass.
	.244" Aluminium to .050" in one pass.
FERROUS.	.128" Mild Steel to .031" in three passes.
	.150" Mild Steel to .065" in three passes.
	.187" 7% Carbon Steel to .130" in two passes
Finishing reduction of .001" up to 3" wide.	
FLOOR SPACE.	3' 8" x 3' x 5' high.
MOTOR DRIVE.	10 h.p. 3 phase, 50 cycles standard fitting.

As used by many of the largest firms in the World for rolling: STAINLESS STEEL, COPPER NICKEL ALLOYS, HIGH CARBON STEEL, MOLYBDENUM, TUNGSTEN, GILDED METAL, NICKEL SILVER, BRASS, ALUMINUM, FANCY PATTERNS, OVALS, HALF-ROUNDS and SHAPES.



Right: Illustrating worm drive to Roll Shafts.



The 'DECO' Hydraulic Spooling Machine, Model 'HT'

Designed and built as a HIGH PRECISION MACHINE for layer winding wire or flat tapes where freedom and accuracy of take off is required.

All moving parts run on ball or roller bearings and efficient lubrication ensures the minimum of maintenance.

SPOOL CAPACITY

Core diameters 2½" to 34". Flange diameters up to 36". Pancakes. Tapes and flats layer wound up to 8" spool width. Maximum weight of coils 2½ cwt.

COILING SPEEDS

Spool shaft from 50 to 300 r.p.m.

TRAVERSE—FULLY HYDRAULIC

Giving an infinitely variable pitch from pancaking up to ⅝", easily adjusted by graduated control.

TENSION

Tension can be adjusted to suit any wire from 33 gauge up to .250" by means of an adjustable sensitive plate clutch.

MEASUREMENTS

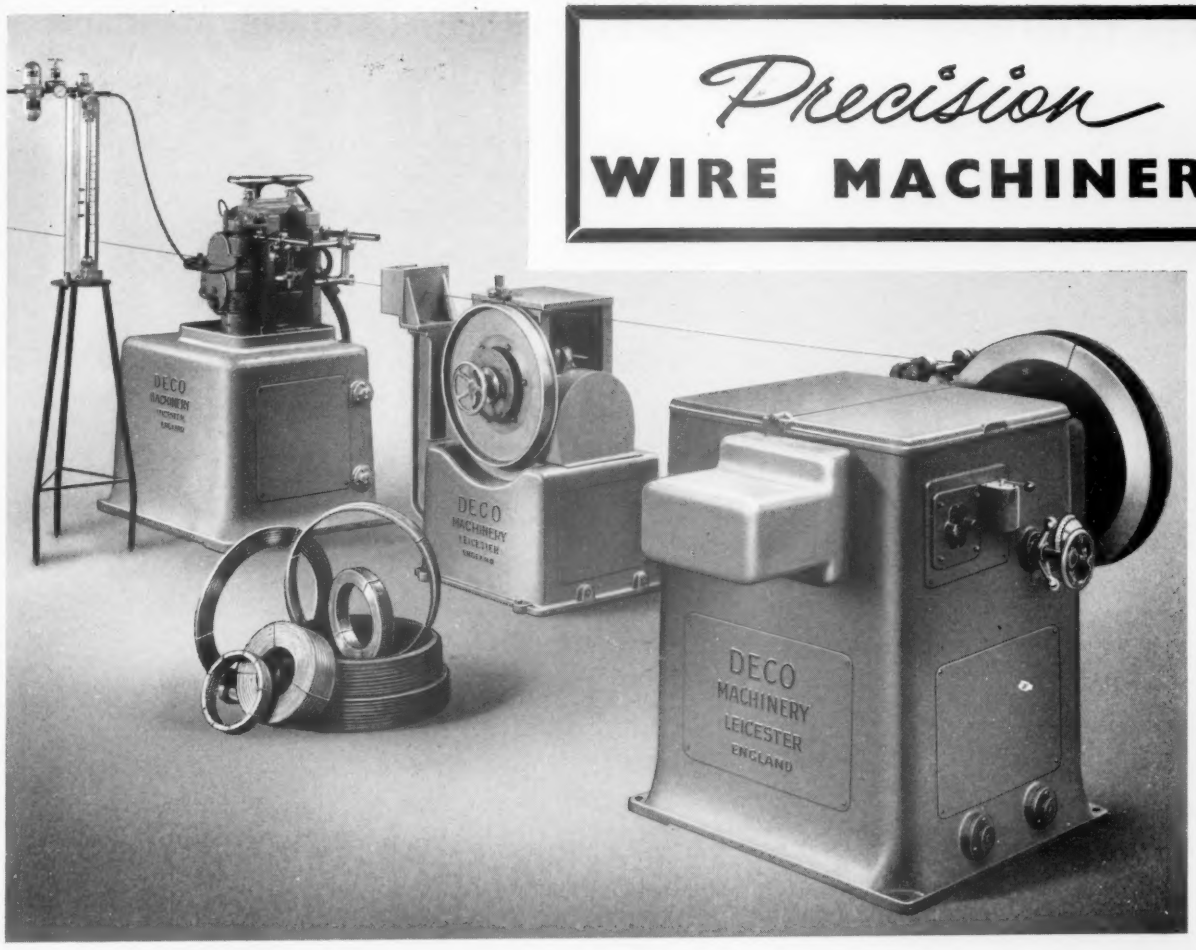
Floor area 6 ft. x 4 ft. Approx. weight 18 cwts.

MACHINERY LIMITED
DECO
LEICESTER ENGLAND

Sole Agent for U.S.A. & Canada

PAUL REICHER
P. O. BOX 127
WILLOWDALE
ONTARIO
CANADA

Precision WIRE MACHINERY



SOLEX AIR-OPERATED GAUGE

Large indicator gives continuous precision readings showing variations to .0001".

DECO 26 WD WORM DRIVE, PRECISION WIRE FLATTENING MILL

Worm and Worm-wheel drive to Roll Shafts.
Automatic Lubrication to all Bearings.
Rolls 6" dia. x 4" wide, hardened to 64-65 Rockwell Scale C.
Internal and/or external water cooling to Rolls.
Performance at 250 feet per minute.

NON-FERROUS

.267" diam. Copper to .125" in four passes
.104" diam. Gilded Metal to .042" in one pass
.244" diam. Aluminium to .050" in one pass

FERROUS

.128" diam. Mild Steel to .031" in three passes
.150" diam. Mild Steel to .065" in three passes
.187" diam. .7% Carbon Steel to .130" in two passes.

DECO 25 BP BULL PULLEY

For precision drawing round or flattened wire, or for Pancake or slab winding coils of ferrous or non-ferrous strip. Adaptable for many special applications on multi-operational processes.

Ideal for finishing passes on sheared or rolled strip.

THE DECO H.T. HYDRAULIC SPOOLING MACHINE

Spool Capacity

Core diameters 2½" to 34". Flange diameters up to 36". Pancakes. Tapes and flats layer wound up to 8" spool width. Maximum weight of coils 2½ cwt.

Coiling Speeds

Spool shaft speed from 50 to 300 r.p.m.

Traverse—Fully Hydraulic

Giving an infinitely variable pitch from pancaking up to ¾" easily adjusted by graduated control.

Measurements

Floor area 6 ft. x 4 ft. Approx. weight 18 cwts.

MACHINERY LIMITED
DECO
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PAUL REICHER
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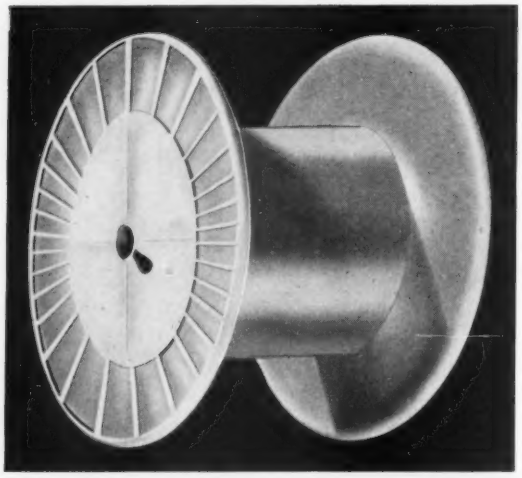
CANADA

NEWLY DEVELOPED NON-RETURNABLE PLASTIC SHIPPING SPOOLS



FOR MAGNET WIRE

DESIGNED FOR:

LIGHT WEIGHT • LOW FREIGHT COSTS • LOW INITIAL COST • HIGH IMPACT STRENGTH TO WITHSTAND SHIPPING DAMAGE • RIGIDITY AND ACCURACY FOR SUPERIOR WINDING OF MAGNET WIRE IN FINE GAUGES.

NON-RETURNABLE — NO DEPOSIT CHARGES.

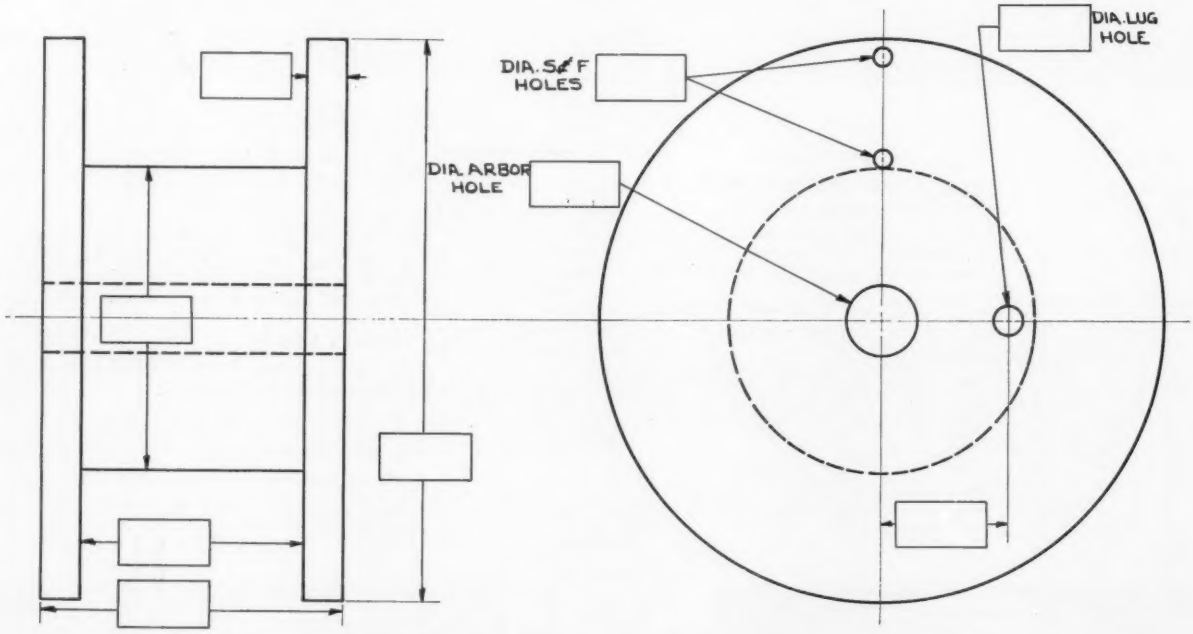
Fill out form below and SEND TO:

HUBBARD SPOOL COMPANY

GARRETT, INDIANA
Tel.: Garrett 840

MANUFACTURERS OF A COMPLETE LINE OF SPOOLS AND REELS — ALL CONSTRUCTIONS

TEAR HERE



ADDITIONAL REMARKS (TYPE OF MATERIAL, ETC.)

COMPANY NAME

REQUESTED BY

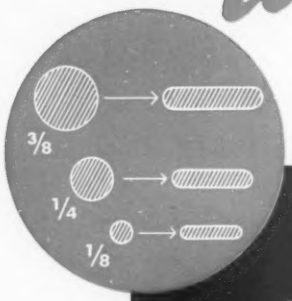
ADDRESS

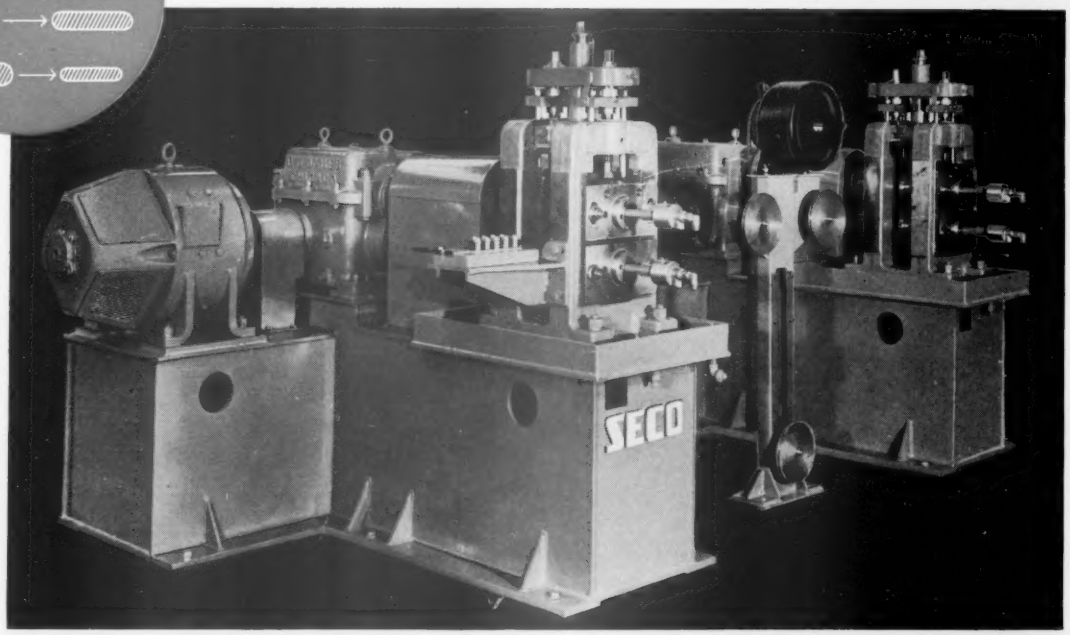
SECO

When You See SECO You're Seeing the Best!

Wire FLATTENING MILLS

Meet Today's High Standards of Quality and Efficient Operation





Shown above is the SECO 6" Tandem Mill with carboloy rolls and Timken Tapered Roller Bearings. Speed range is from 200 to 800 fpm. The mills are driven by DC motors through combination worm-helical reducers with universal joints, for silent and vibrationless operation. 8" and 10" mills of the same design and construction are also available. Suitable traverse reels are furnished.

Call or write for information and complete data. Consultation invited — no obligation.

STEEL EQUIPMENT COMPANY
P. O. BOX 737, WARRENSVILLE STATION
CLEVELAND 22, OHIO

SECO

DRAW BENCHES

Single & Dual Chain

Single, Double, Triple & Five Draw

Wire Drawing Blocks

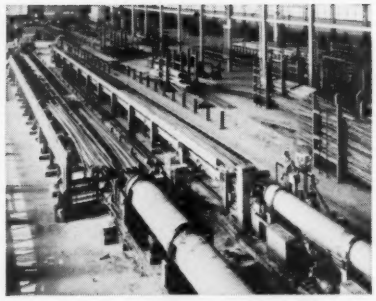
Loading Racks

Draw Bench Chains

Pinch Rolls

Carriage Head (Air-Operated)

Hooks (Air-Operated)



5-DRAW

COLD DRAW EQUIPMENT

for TUBES · BARS · SHAPES

Piercing Mills

Bull Blocks

Cold Reducing Mills

Squeeze Pointers

Rotary Bar Pointers

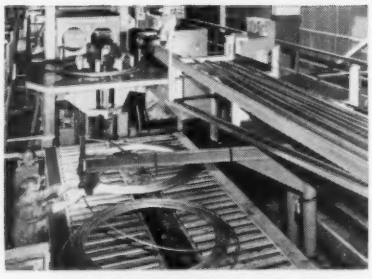
Run-Out Tables

Gag Straightening Presses

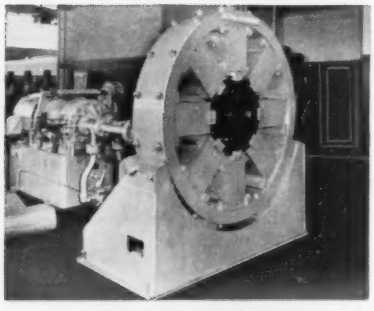
Rotary Roll Straighteners

Cracker Shears

Bar Shears



BULL BLOCK



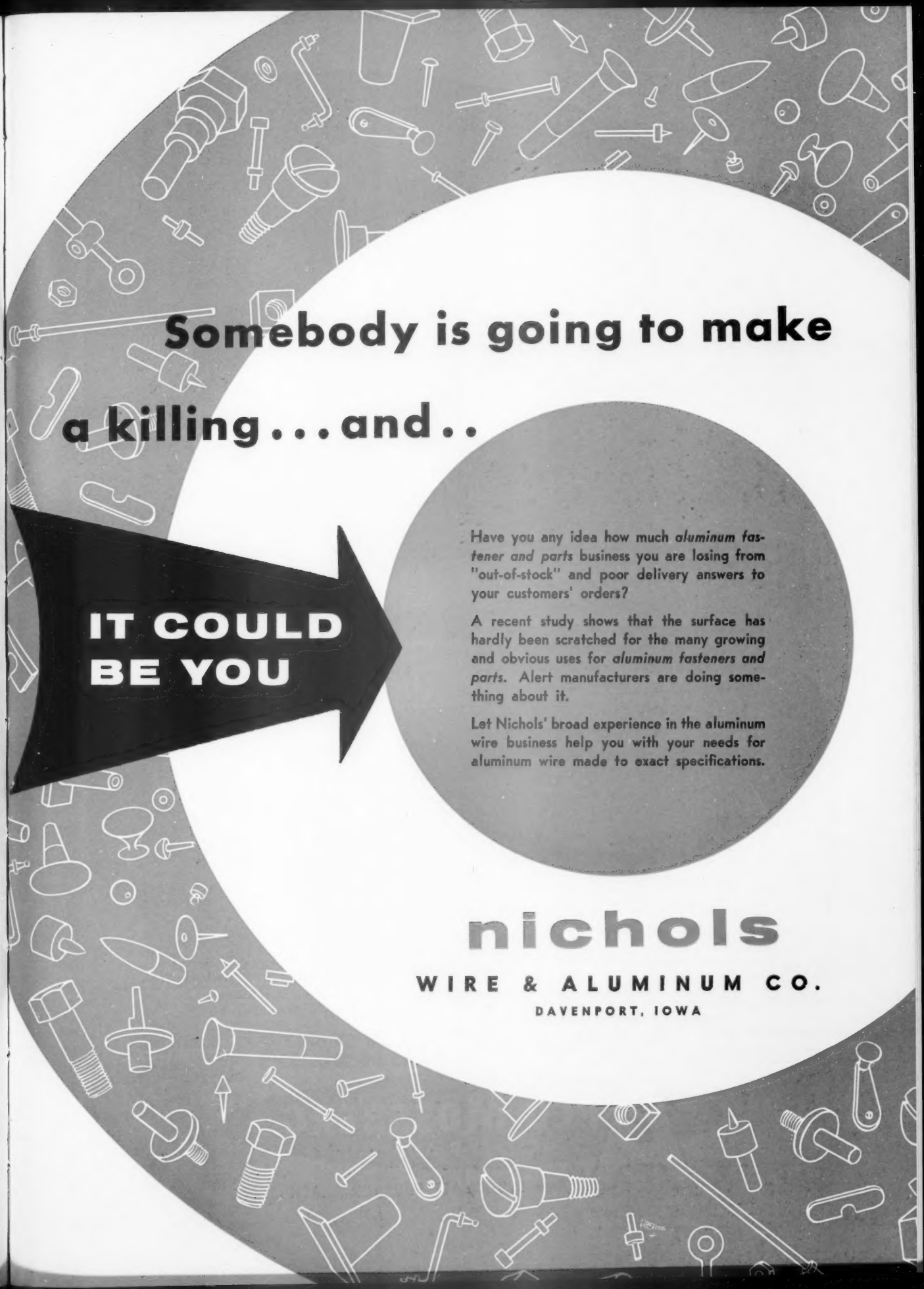
SQUEEZE POINTER

AETNA • STANDARD

THE AETNA-STANDARD ENGINEERING COMPANY

GENERAL OFFICES: PITTSBURGH, PA. PLANTS: ELLWOOD CITY, PA., WARREN, OHIO

CONTINUOUS GALVANIZING LINES • CONTINUOUS ELECTROLYTIC TINNING LINES • SIDE TRIMMING AND SHEAR LINES AND OTHER FINISHING EQUIPMENT • CONTINUOUS BUTT WELD PIPE MILLS • SEAMLESS TUBE MILLS • DRAWBENCHES AND OTHER COLD DRAW EQUIPMENT • ROLLS AND CASTINGS • EXTRUDERS, MILLS, PRESSES FOR RUBBER AND PLASTIC



Somebody is going to make a killing . . . and . .

IT COULD BE YOU

Have you any idea how much *aluminum fastener and parts* business you are losing from "out-of-stock" and poor delivery answers to your customers' orders?

A recent study shows that the surface has hardly been scratched for the many growing and obvious uses for *aluminum fasteners and parts.* Alert manufacturers are doing something about it.

Let Nichols' broad experience in the aluminum wire business help you with your needs for aluminum wire made to exact specifications.

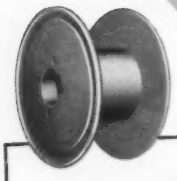
nichols

WIRE & ALUMINUM CO.

DAVENPORT, IOWA

Worth looking into . . .

APCO MOSSBERG STEEL REELS AND SPOOLS



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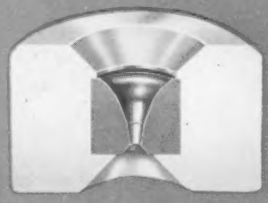

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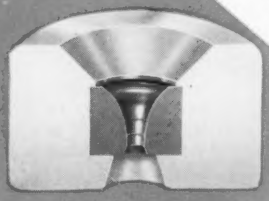

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The Wire Outlook

A large segment of the production and engineering personnel from the many mills that comprise our wire industry—and a good number from various foreign countries—will be foregathering in Chicago this month to participate in the activities of The Annual Convention.

To these men the Directors and Officers of The Wire Association bid a most cordial welcome and express the hope that your four-day stay in Chicago will be a rewarding one. To our many members who would like to be with us on this eventful occasion, but who must remain behind to keep the wheels of the industry turning, they send through this medium their greetings and good wishes.

While the optimists are in the majority, there is a growing feeling of doubt about next year, expressed in the gyrations of the stock markets. Factors contributing to it are that many companies will show smaller net profits this year; that capital spending shows signs of leveling off; that big inventories of cars must be worked off; that money is to be kept "tight"; that government spending may be reduced; that consumer buying is not increasing as in former years in spite of price cutting; and that most plant capacities are generally greater than the demand for goods.

On the other side of the ledger, many informed observers believe that defense spending will hold up; that corporate earnings will be satisfactory; that capital spending, while not increasing, is still heavy; that auto sales in 1958 will exceed those of 1957; that home building will increase by 10% next year; that inventories are not overlarge; and that high interest rates will only defer many business ventures until a time when we will need them more than now. The long-range outlook is widely conceded to be good.

Additional disclosures regarding union racketeering and mismanagement are yet to be brought into the open. Many labor unions are due for a big housecleaning, but it is going to take some years to effect a thorough change of the ways of union management that have virtually enslaved our workers and led to so much unnecessary labor turmoil.

There is no cogent reason why the unions should have immunities to responsibilities to which other segments of our society are subject, especially since the powers accorded to unions in an effort to get labor votes have been so flagrantly abused. A housecleaning of the statutes governing union activities is also an essential job for our lawmakers, in which the general welfare of the country is a paramount consideration.

Copper prices took another nosedive in September. The effect of this will be to squeeze out many marginal mining operations; if it does, copper prices will again rise before long.

Wire orders for September showed a small increase. Most inventories are low, but have not been reduced fast enough to make any substantial change in the industry status. Fastener and furniture spring consumption has been slow, but automotive demand for wire is picking up for new model production. Welded wire fabric has shown some increase in orders. Merchant wire products are generally available on a two to four week delivery. The demand for wire goods, broadly speaking, is not too good. High tensile wire for prestressed concrete work is one bright spot. About the only wire producers in the country who are operating in high gear are those on the West Coast.

The anomaly of the slowness of the wire industry, as compared with general business, is something that is not going to be adjusted in a moment. The problems of the industry will be solved through the combined efforts of managements and through the sheer growth in the consuming power of the public as new thousands each year come into the markets with their pressing needs.

Edmund Duval Sickels
EDITOR

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Vol. 32 OCTOBER, 1957 No. 10

Combined Hot Rolling and Patenting of Rod

by Dartrey Lewis
Chief Engineer, Research and Development
John A. Roebling's Sons Corporation
Trenton, New Jersey

A paper prepared for presentation at the Annual Convention of The Wire Association in Chicago on October 15, 1957.

Mr. Lewis graduated from Sheffield University, England, as a M. Metallurgy and has engaged in research and development work ever since. Before joining Roebling he was with the Woolwich Arsenal, American Chain Company and Manning, Maxwell and Moore, Inc.

Introduction

In 1854 **James Horsfall** of Hay Mills, Birmingham, England, patented a process for manufacture of music wire[1]. Ever since that time the heat treating process he devised has been called "patenting." Traditionally patenting has been a separate operation from hot rolling. This paper is concerned with combining patenting with hot rolling.

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The idea of heat treating steel as it comes from a rolling mill goes back at least as far as 1887. In that year John Coffin[2] developed a method for heat treating rails as they came from the rolling mill. In 1890 Carl Wilhelm Bildt[3] of Worcester, Massachusetts, invented a process for heat treating wire rods as they came from the rod mill by cooling them in a water trough. In 1930 the Morgan Construction Company[4] improved this process by pumping cooling water into the guide pipes and providing a water separator to prevent the water from going on to the reel.

Experimental Patenting on Rod Mill

In 1949 John H. Corson suggested that the rod could be patented during hot rolling by extending Morgan's water cooling. At that time Corson was a metallurgist with **John A. Roebling's Sons Corporation.** The experimental work started by Corson was continued by **George A. Goetz, Howard F. Stirn, George R. Hulick** and the writer. Experiments were made with a Morgan continuous rod mill which rolled No. 6 (.187" diameter) rod in twenty passes and No. 5 (.218" diameter) rod in eighteen passes from 2" x 2" billets. The finishing speed for No. 6 rod was 4080 F.P.M. (68 F.P.S.) and for No. 5 (.218" diameter) rod was 3420 F.P.M. (57 F.P.S.). The mill also rolled larger sizes at slower finishing speeds.

Dartrey Lewis

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The distance between the finishing stands and the reels was about 25 feet. Half of this distance was occupied by water filled guide pipes through which the rod passed. This arrangement was Morgan's conventional water cooling and was used to reduce the rod temperature from about 1800°F to about 1500°F prior to reeling. Corson found that by reducing the finishing speed and increasing the cooling water pressure he could reduce the rod temperature to a black color as it went to the reels. He was able to draw 0.65% carbon rod treated in this way seven holes for a total reduction of area of 89%, but the results were not consistent. He found that when the rod was cooled sufficiently to obtain a fine pearlite at the center,

the surface was over-cooled. A cross-section examined under the microscope showed an outer ring of darker etching material which was either Bainite or tempered Martensite.

Temperature Gradient from Surface to Center of Rod

Calculations made by Goetz, and later confirmed by **V. Paschkis** in Columbia's Heat Flow Analog Computer Laboratory, showed that the difference in temperature between the surface and center of the water cooled rod was 700°F or more. It was thought that this excessive temperature gradient might be avoided by extending the distance between the finishing roll pass and the reels and by water cooling the rod in four separated stages. Paschkis' laboratory made calculations for such a design and came up with the temperature distribution shown in Fig. 1. In these calculations the amount of cooling at each stage was limited to bring the surface temperature down to 1000°F at the first, second and third cooling stations, and to 900°F at the fourth cooling station. The space between the cooling stations gave time for the surface and center temperatures to equalize.

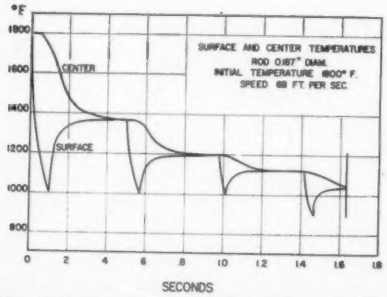

Fig. 1—Center and outside temperatures of .187" diam. rod moving 4050 F.P.M. Water cooled in 4 stages with dry guide pipes between stages. Distance from finished rolls to reels 110 ft. * *

For a time the idea of intermittent cooling was just a theory. However, in 1951 it was decided to convert the rod mill from two strands to three. The new reels were placed 110 feet from the finishing roll stands in order to accommodate four water cooling stations.

Metallurgy of Patenting

There are other problems involved in patenting during hot rolling in addition to the temperature distribution in the rod. In order to explain these problems it is desirable to discuss the metallurgy of patenting.

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From the days of James Horsfall to as late as 1932 the technical nature of patenting was little understood by wire men. However, metallurgists working in other fields have developed the theory of heat treatment of steel in some detail, and at the present time the nature of patenting is fairly well understood.

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In simple language, patenting consists of heating high carbon steel rod or wire to a temperature high enough to take the iron carbides into solution in the iron and then cooling the steel to a temperature at which the iron carbides separate in the form of very thin plates called fine pearlite.

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The heating part of this process is performed very well in the rod mill. The billet heating furnace takes the carbides into solution and the finishing temperature of a continuous rod mill (1700° to 1800°F) is a very suitable temperature from which to start the cooling part of the process. The cooling is complicated by the speed of travel, which is about 100 times faster than the usual patenting speed.

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A technical understanding of the cooling part of patenting can be obtained from a study of Fig. 2, which shows an isothermal transformation diagram for an 0.89% carbon steel[7]. The data for this diagram was obtained by heating small samples to 1625°F and quenching them in a suitable liquid at various temperatures from 1325°F down to room temperature. The samples were held at these temperatures for various times up to a week, which is the reason for the name isothermal transforma-

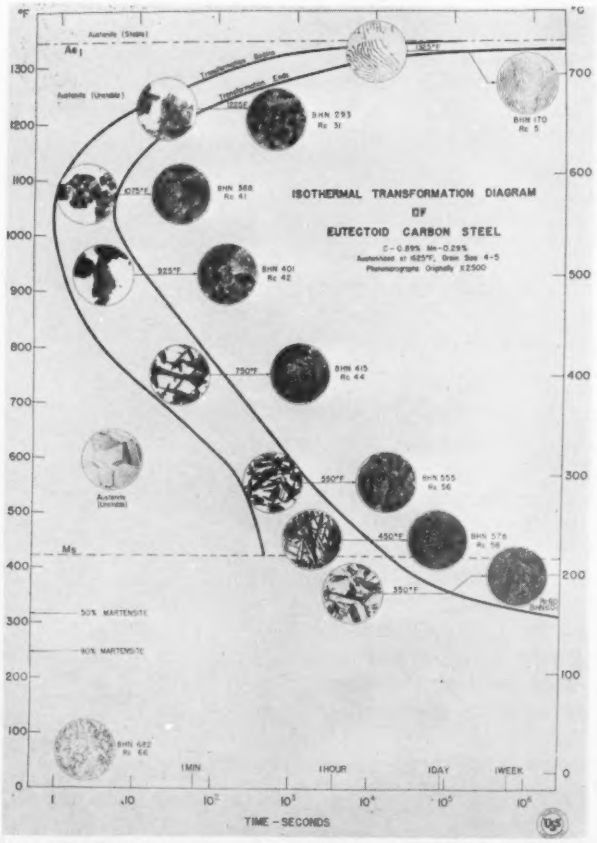

Fig. 2—Isothermal transformation diagram for eutectoid carbon steel. (Courtesy of U. S. Steel Corp.) * * * * * * * * * * * * *

tion. The microstructure and hardness after these treatments was determined.

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Fig. 2 shows that at 1325°F the carbides come out of solution slowly. It takes about a day for complete separation. At this temperature the carbides separate as thick plates (coarse pearlite). Such a structure is soft (about 95,000 p.s.i. tensile strength) but it cannot be cold drawn much because the thick plates of iron carbide are brittle and fracture during wire drawing. When the carbides separate at 1225°F the steel is somewhat harder (tensile strength 130,000 p.s.i.) and the plates of iron carbide are much thinner (fine pearlite). Such a material can be cold drawn more before it becomes brittle. At this temperature the carbides come out of solution in about one minute.

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Hot rolled high carbon rods do not draw well because the interior of the compact rod coil cools slowly in the range 1325° to 1225°F. The time in this temperature zone considerably exceeds one minute and consequently some coarse pearlite forms.

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Referring again to Fig. 2, as the temperature is lowered the velocity at which iron carbide forms increases until it reaches a maximum, at about 1025°F. At this temperature carbide starts to come out of solution in about one second and is completely formed in about five seconds. The structure is so fine it cannot be resolved under an ordinary microscope. It consists of thin plates of iron carbide (fine pearlite) but this was not certain until the electron microscope became available[5].

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At lower temperatures in the range of about 925°F to 425°F the carbides come out of solution more slowly and in a different form. They have an acicular structure called Bainite. Bainite can be cold drawn but the ductility of the drawn wire is inferior. At temperatures below 425°F the steel transforms to Martensite, which is very hard and brittle.

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Thus in order to produce a satisfactory patented structure in hot rolled rod it is necessary to cool it rapidly through the temperature range 1325° to 1225°F to avoid formation of coarse pearlite, and then to hold it within the range 1025° to 1225°F for (say) ten seconds, to allow the carbides to come out of solution. It is important that the steel is held long enough in this temperature range for the carbides to form completely because any which separate below about 925°F will be in the undesirable form of Bainite or Martensite. By following such a procedure in the rod mill a satisfactory structure can be obtained. Fig. 3 shows the microstructure of .75% carbon rod patented in the rod mill. The microstructure of typical hot rolled rod is shown for comparison.

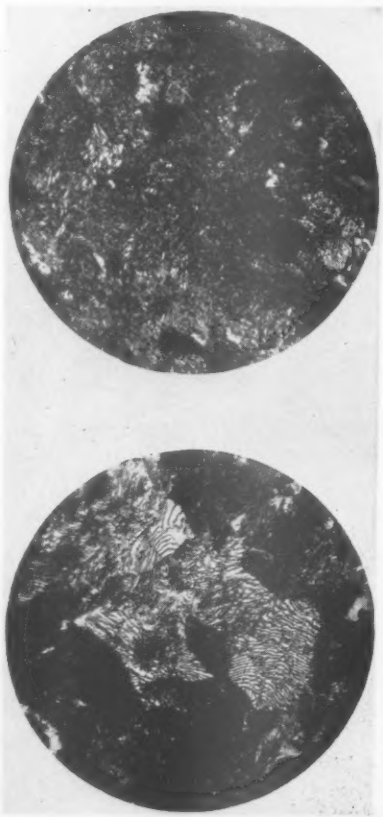

Fig. 3—Top: 75% C rod patented on rod mill. Notice the fine pearlite. X1000. Bottom: 75% C hot rolled rod. Notice the coarse pearlite. X1000

Installation of Rod Patenting Equipment

The technical principles just described were applied to the design of the cooling system for the new third rod strand. The cooling stations were designed according to Paschkis' calculations so that the rod was cooled rapidly but without cooling the surface below 900°F. The temperature of rod upon reaching the reel was within the range 1025° to 1225°F. The cooling time was 1.6 seconds and the distance from the finishing rolls to the reel was 110 feet.

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The rod was then coiled on the reel which delayed further cooling and allowed the carbides to form before the temperature fell below 1000°F. A phenomenon called recalescence occurs when the carbides separate. Heat is generated and the rod temperature increases about 100°F. This effect was distinctly visible. The rod entered the reel at an almost black temperature and became red during reeling.

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The bottom plate and guide pins on the reel caused a problem because the parts of the rod in contact with them were cooled more rapidly than the rest of the coil. It was found that if the reeling temperature was too low, tempered martensite would form at these contact points. In order to avoid this it was necessary to reel at temperatures not below 1150°F.

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To assist the rod in its passage through 110 feet of guide pipe, the cooling nozzles were designed to produce a water flow through the guide pipe in the direction of rod travel at about the same speed as the rod. The design of one of the cooling nozzles is shown in Fig. 4. The first cooling station had four such nozzles; the second cooling station had two; the third cooling station had one, and the last cooling station had one. Between the cooling stations was a dry guide pipe in which the temperature of surface and center of the rod had opportunity to equalize. In order to prevent the water

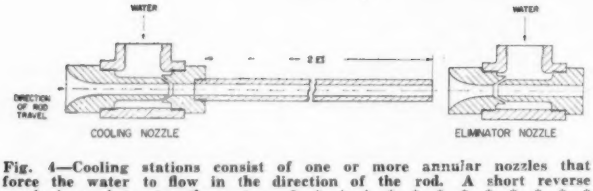

Fig. 4—Cooling stations consist of one or more annular nozzles that force the water to flow in the direction of the rod. A short reverse nozzle is used to stop the water.

from going into the dry pipes, short eliminator nozzles were installed in an opposing direction. Cooling water was supplied at 100 p.s.i. by centrifugal pumps. The cooling water flowed continuously through the nozzles so that the rod was patented along its full length. This was contrary to the prior procedure in which the cooling water was turned on after the starting end of the rod had reached the reel. The general arrangement of the cooling lines and take-up reels is shown in Fig. 5. Photographs of the cooling lines are shown in Figs. 6 and 7. Fig 8 shows the fourth cooling station.

A method was developed for measuring the temperature of rapidly moving rods. A radiation pyrometer was obtained having a 1/8" diameter field of view and a suitable rod guide was designed. With this equipment it was possible to record the temperature of 3/16" diameter rod moving 4000 F.P.M. The guide was designed so that it would offer little resistance to the passage of the rod even when overfills were present. At the same time the area on which the Rayotube focused was held steady. The design of the guide is shown in Fig. 9. The area of focus of the Rayotube is shown at the spot

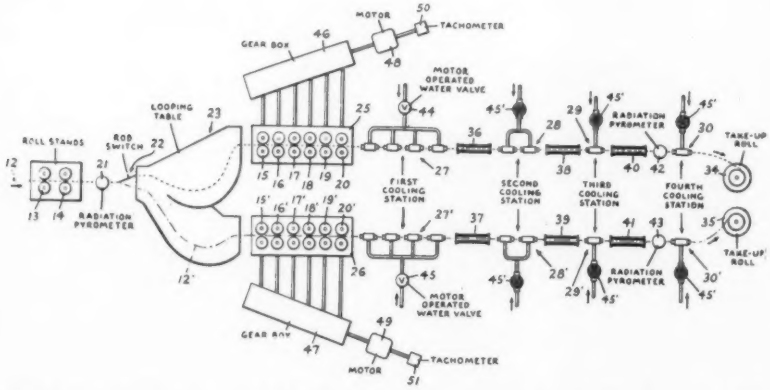

Fig. 5—General arrangement of the heat treating system. Motor-operated valves are controlled by pyrometers 21, 42, and 43.

Fig. 6—Cooling lines looking from the finishing rolls. Note the 4 cooling stations with dry pipe lines between.

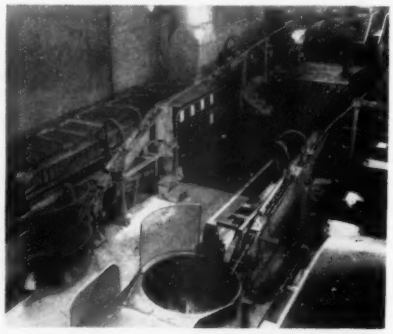

Fig. 7—Cooling lines looking from the reels. Note temperature panel control panel.

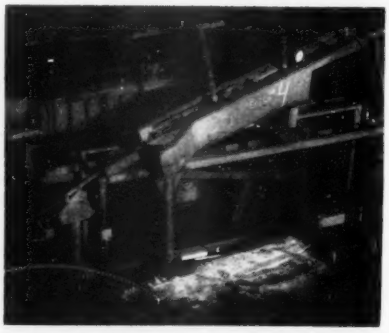

Fig. 8—4th cooling station. Notice radiation pyrometer ahead of cooling nozzles.

Automatic Temperature Control

During the experimental work it was soon apparent that automatic temperature control would be required. For example, it was found that the billets were not uniform in temperature from end to end. In particular the rods were always hotter at the back end of the coil. Also temperature variations occurred due to mill delays and to variations in cooling water on the mill. For the purposes of automatic control it was found that the temperature could be controlled by regulating a valve in the cooling water supply line.

marked 79. This equipment was placed prior to the fourth cooling stations. (Figs. 5 and 8)

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The temperature of the rod was also measured before cooling between the 14th roll stand and the looping table (Fig. 5). The temperatures indicated by the radiation pyrometers ahead of the final cooling stations were used to control the reeling temperature. The temperature indicated by the radiation pyrometer ahead of the looping table was used to obtain a uniform temperature along the length of rod. Both temperature

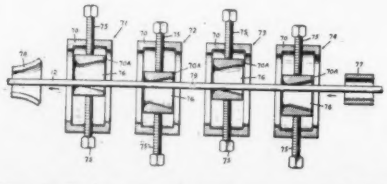

Fig. 9—Design of rod guide for the radiation pyrometer. The focal area for the pyrometer is shown at 79.

(*Please turn to page* 1262)

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Comparison of Gas and Electric Strand Annealing Furnaces

by Harold Notarius
Mechanical Engineer
Wilbur B. Driver Company
Newark, New Jersey

This paper was prepared for presentation at the Annual Convention of The Wire Association in Chicago on October 15, 1957.

A complete analysis was made of two furnaces, one gas fired and the other electrically heated, that are used to strand anneal wire continuously. Both units were of the same size and operated under similar conditions. The furnaces were compared as to costs, efficiencies and heat losses to determine which one was better suited to our needs.

The quality of anneal is the same, regardless of the furnace used. It was found, however, that the electric furnace, although more expensive initially, was cheaper to operate and maintain and created less heat nuisance in the surrounding area. When choosing a unit to strand anneal wire continuously under a protective atmosphere and at a relatively high temperature between 1400°F. to 2150°F, the author, on the basis of this study, would recommend an electric over a gas furnace.

Introduction

Which type of furnace, gas or electric? This question often arises when it is necessary to obtain another furnace. The decision usually has to be made on the basis of the particular usage of the unit and on the relative costs—initial, operating and maintenance.

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Our company was faced with this problem. As a major producer of nickel-chrome and other alloys, the plant makes extensive use of annealing furnaces. Many of the units are of the continuous operating type and use a protective atmosphere to shield the alloy. When we wanted to obtain additional annealing capacity, it was necessary to decide whether an electric or a gas furnace would be better suited to our purposes.

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In our manufacturing processes, most of the furnaces are gas fired, although some are electrically heated. For comparison purposes it was decided to make a survey of the ten foot wire annealing furnaces, because in this size we had each type in operation and an additional one was needed.

Description of Furnaces

Both types of furnaces under study are of the same approximate size and can be used interchangeably for annealing purposes. Basically, each houses forty ¾" Inconel tubes through which the wire to be annealed passes. A protective atmosphere (cracked ammonia) flows counter to the wire and is burned at the wire entrance. The heat for annealing is transmitted through the Inconel tubes to the wire. When the tubes are maintained at the desired temperature level, the quality of anneal is the same, regardless of whether the furnace is electrically heated or gas fired. Therefore, the choice of furnace rests on factors other than the quality of the product. Costs—initial, operational and maintenance—and the effect on ambient conditions, are values to be weighed in making a selection.

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The electric furnace is an electrically heated box, ten feet long, five feet wide and four feet high, of 60 kw capacity, with a maximum operating temperature of 2150°F. (Fig. 1). The temperature is maintained at its desired level by two on-off control instruments. Preformed Tophet A ribbon is used as the resistance heating element. Forty Inconel tubes, ¾" nominal size, pass through the chamber and act as individual muffles to enclose the wire being annealed in a protective atmosphere. Fifteen inches of insulation enclose the work area and the entire furnace is cased with ¼" steel plate.

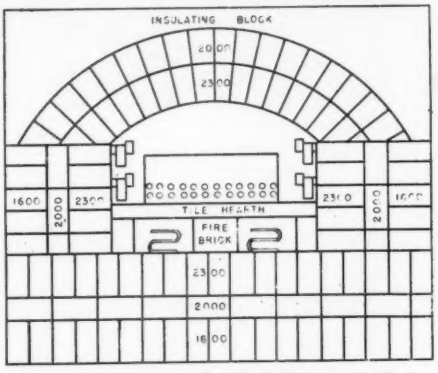

Fig. 1—Cross section of electric furnace. * * *

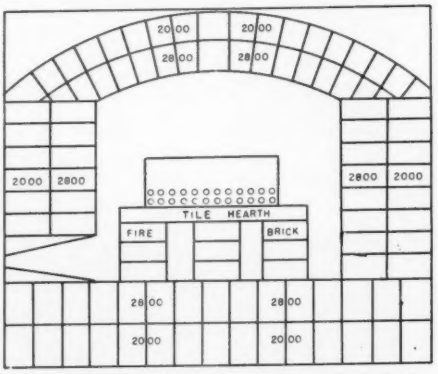

Fig. 2—Cross section of gas furnace. * * * *

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The gas furnace is approximately the same size, with the same size, number and type of tubes. (Fig. 2) City gas is used and the temperature is automatically controlled by high-low firing. The fire box area of the furnace is enclosed with nine inches of insulation and the casing is again ¼" steel plate.

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Figures 3 and 4 show the pay-

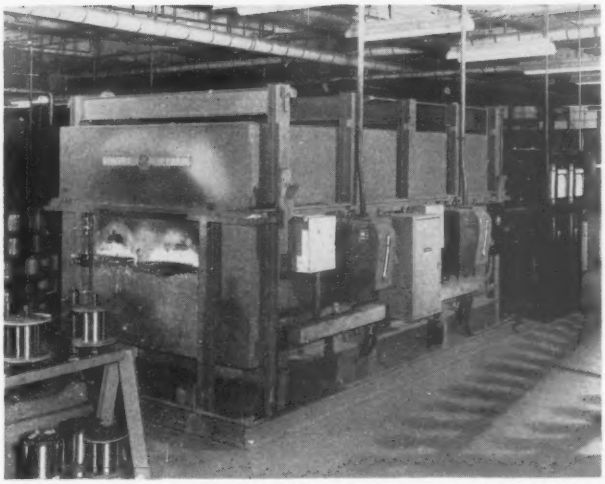

Fig. 3—Electric strand annealing furnace. * * * * * * * * * * *

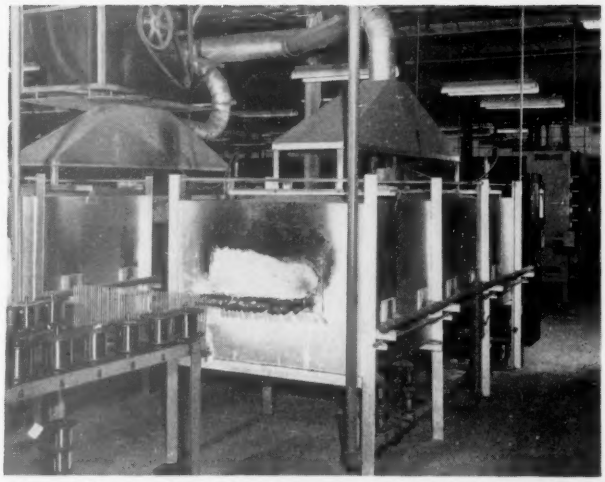

Fig. 4—Gas strand annealing furnace. * * * * * * * * * * * *

off ends of the two furnaces which were studied. Sizes and types of insulating brick are shown on typical cross-sections in Figures 1 and 2. In each furnace the tubes are supported on a hearth. The gas unit is fired through side ports, with the flame underneath the hearth and the hot gases enveloping the tubes and exiting through flues in the roof. The electric unit has its resistance elements placed beneath the hearth and hung from the side walls.

Discussion

General

Data were collected on the two furnaces for a period of a month. Daily readings were taken of:

Type of Alloy
Diameter of Wire
Annealing Temperature
Number of Strands
Speed of Wire
Meter Readings

★ ★ ★

It must be borne in mind that this report concerns itself only with a special set of conditions:

(1) That the temperature range is between 1400 to 2150°F.
(2) That the operation is continuous, twenty-four hours a day, seven days a week.
(3) That the wire or strip is protected by an Inconel Pipe Muffle.
(4) That the wire itself is continuously annealed and not batch annealed.
(5) That the amount of heat stored in the refractory is not a factor.
(6) That the temperatures are kept constant over a prolonged period of time and that sudden changes in temperature are not desirable.
(7) That gas costs are approximately ninety cents ($.90) per 1,000,000 btu's and electric $1.75 per 1,000,000 btu's.

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During the test period, the two furnaces operated at various temperatures. Depending on the alloy being annealed, the operating level ranged from 1500° F to 2150° F; however, for the twenty working days that data were taken, the furnaces were at 1750° F for more days than at any other temperature. Therefore, all calculations have been based on the data collected at this temperature. Data collected at other temperatures were used only as a guide when interpolating from the 1750° F calculations.

★ ★ ★

Room temperature was assumed to be a constant 80° F during the test period. Actually this figure varied slightly from day to day, but this variation was negligible.

★ ★ ★

Data sheets No. 1 and No. 2 are samples of the data as it was collected and Bar Graphs No. 1 and No. 2 are a summary of the results obtained from these data sheets.

Useful Work of Furnace

The energy necessary to heat the wire for annealing purposes is considered useful work and is calculated by the following formula:

$$H_w = T_f - T_r \times \text{Sp. Ht.} \times \text{Wt./hour}$$

where:

H_w = **Energy absorbed by wire in btu/hour.**
T_f = **Furnace temperature, °F.**
T_r = **Room temperature (wire temp. entering furnace), °F.**
Wt = **Weight of alloy annealed in lb./hour**
Sp. Ht = **Specific heat of alloy, btu/lb./°F.**

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A constant specific heat of .11 btu/lb./°F is used. In actuality, the specific heats vary as much as 5% from alloy to alloy; however, this variation does not seriously affect the accuracy of the calculations.

★ ★ ★

The temperature of the wire entering the furnace was slightly higher than room temperature, since it picked up heat from the burning protective atmosphere. Since it is impractical to measure this slight rise, room temperature is assumed. While this assumption increases the thermal efficiency, it applies equally to the gas and electric furnaces and can be neglected.

Furnace Losses

Certain losses are equal for both furnaces when operated at the same temperature.

★ ★ ★

The heat added to the protective atmosphere is one such loss. This is determined by:

ELECTRIC FURNACE

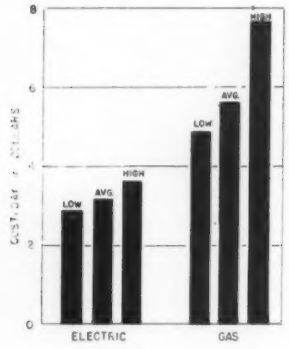
DATA SHEET

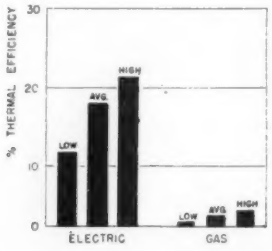
	1 Dia. Wire	2 Oper. Temp.	3 Wt./ 24 hrs.	4 KWH	5 Btu's Supplied	6 Btu's Absorbed	7 Thermal Eff.	8 Cost/ Day
1	0.0285	1750	1395	560	1,920,000	260,000	13.5	$2.80
2	0.016	1500	397	480	1,638,000	63,000	3.9	2.40
3	0.0285	1500	1265	400	1,365,000	199,000	14.6	2.00
4	0.0226	1750	1364	480	1,638,000	253,000	16.1	2.40
5	0.0285	1750	1545	560	1,920,000	287,000	15.0	2.80
6	0.0285	1750	2610	480	1,638,000	527,000	32.2	2.40
7	0.045	1900	2610	560	1,920,000	527,000	27.5	2.80
8	0.025	1750	1330	480	1,638,000	247,000	15.1	2.40
9	0.025	1750	1410	480	1,638,000	262,000	16.0	2.40
10	0.0285	1750	1688	560	1,920,000	312,000	16.3	2.80
11	0.0253	1750	3190	480	1,638,000	593,000	36.3	2.40
12	0.0226	1750	1575	560	1,920,000	293,000	15.3	2.80
13	0.0253	1750	1575	400	1,365,000	293,000	21.5	2.00
14	0.0226	1750	1575	400	1,365,000	293,000	21.5	2.00
15	0.0253	1750	1595	560	1,920,000	297,000	15.5	2.80
16	0.0226	1750	1415	480	1,638,000	263,000	16.1	2.40
17	0.0226	1750	1415	480	1,638,000	263,000	16.1	2.40
18	0.0226	1750	974	480	1,638,000	181,000	11.1	2.40
19	0.0253	1750	785	480	1,638,000	146,000	8.9	2.40

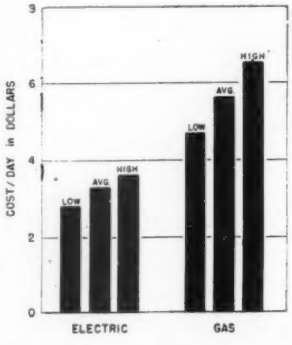
GAS FURNACE

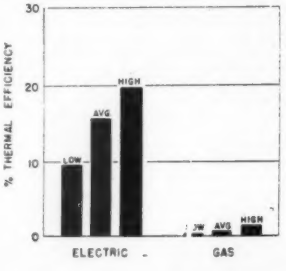
DATA SHEET

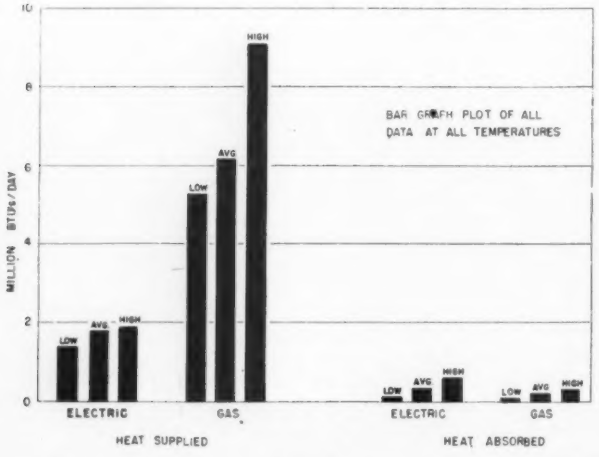
	1 Dia. Wire	2 Oper. Temp.	3 Wt./ 24 hrs.	4 100 cf Gas	5 Btu's Supplied	6 Btu's Absorbed	7 Thermal Eff.	8 Cost/ Day
1	0.0070	1750	177	138	7,690,000	29,900	0.39	$ 6.50
2	0.0070	1750	26	99	5,520,000	4,400	0.08	4.65
3	0.0156	1750	386	119	6,630,000	71,800	1.08	5.60
4	0.0142	1750	342	119	6,630,000	63,600	0.98	5.60
5	0.0142	1750	342	116	6,460,000	63,600	0.98	5.45
6	0.0142	1750	342	116	6,460,000	63,600	0.98	5.45
7	0.0113	1750	195	121	6,740,000	36,300	0.54	5.70
8	0.0100	1750	35	118	6,570,000	6,500	0.09	5.55
9	0.0142	1500	250	93	5,240,000	39,500	0.75	4.40
10	0.0100	1500	250	96	5,350,000	39,500	0.74	4.50
11	0.0100	1550	200	98	5,460,000	32,800	0.64	4.60
12	0.0100	1550	200	99	5,520,000	38,300	0.69	4.65
13	0.0142	1550	266	99	5,520,000	38,300	0.69	4.65
14	0.0142	1500	177	96	5,350,000	25,500	0.47	4.50
15	0.0100	2150	326	143	7,970,000	81,800	1.03	6.70
16	0.0100	2150	326	163	9,080,000	81,800	0.90	7.65
17	0.0131	2150	546	162	9,020,000	137,000	1.52	7.60
18	0.0131	2150	436	163	9,080,000	109,500	1.20	7.65

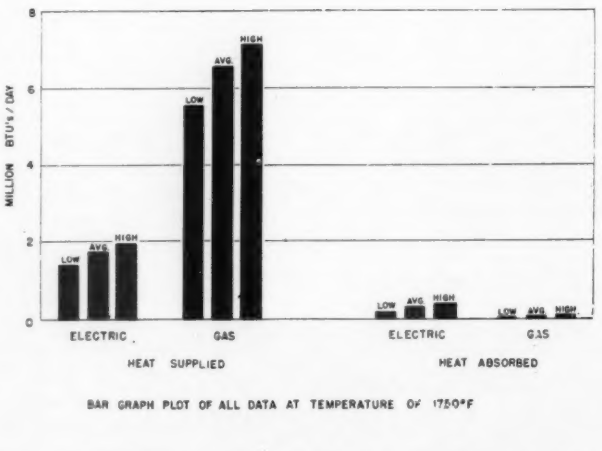












BAR GRAPH PLOT OF ALL DATA AT TEMPERATURE OF 1750°F

H_{atmos} = No. Tubes x Sp.Ht. Gas x ($T_f - T_r$) x Gas Flow

where:

H_{atmos} = Heat added to gas

Sp. Ht. Gas_{cp} = 0.0185 btu/ft³/°F at constant pressure for cracked ammonia (75% H_2, 25% N_2)

T_f = Furnace temperature, ° F.

T_r = Room temperature, ° F.

Gas Flow = 3 ft.³/hr./tube

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Another equal loss is due to radiation, convection and conduction of the hot Inconel tubes which project from either end of the furnace. Since it is difficult to calculate this loss, and since it is small when compared to the other losses of the furnaces, the value is found by difference in the heat balance

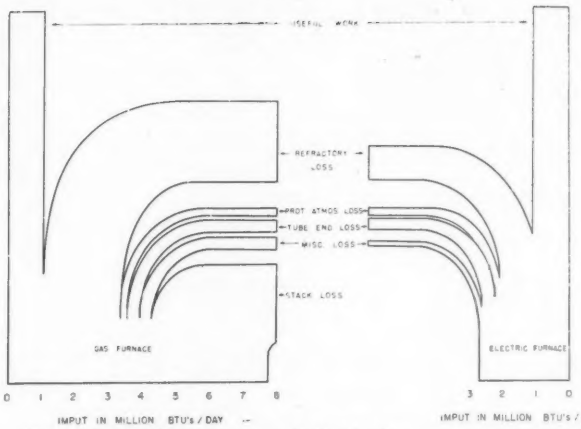

Fig. 5—Heat balance of gas and electric furnaces at 1750°F operating temperature, equal load in both furnaces.

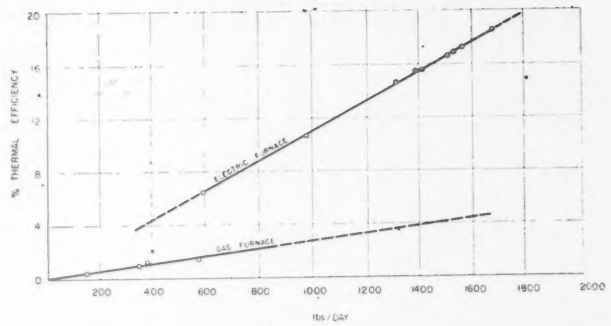

Fig. 6—Efficiency vs. load.

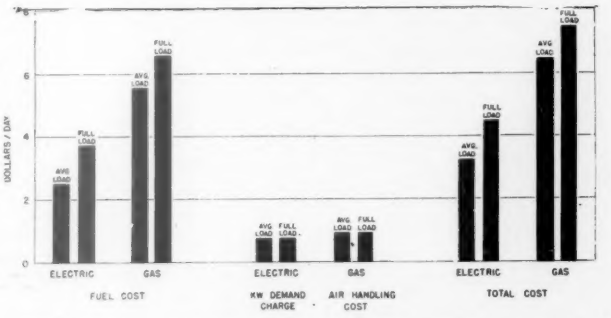

Fig. 7—Daily operating cost of gas and electric furnaces.

of the electric furnace.

★ ★ ★

Refractory losses are not equal but are proportional to the thickness and type of insulation. With a given exterior size, the electric furnace can have a greater volume allocated to insulation, because the resistance heating elements require less space than is required for combustion and passage of gases. In addition the gas furnace must use heavier refractory to withstand the erosion effect of heated gasses attempting to force their way from the furnace envelope and to confine a flame which locally exceeds 3000°F.

★ ★ ★

The refractory loss coefficients are taken from Manufacturers' Data Sheets. This heat loss is found by:

$H_{Refr} = K \times A$

H_{Refr} = Heat Loss in btu/hour

K = Heat Transfer coefficient in btu/sq. ft./hr. for the given thickness and type of insulation and the temperature differential.

A = Inside area of the furnace.

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Actual surface temperature measurements were taken of the casings. On the gas furnace the temperature was 215°F and 135°F on the electric, a difference of 80°F. These measurements may be used as a check of the heat losses previously calculated.

★ ★ ★

Two more losses are attributed to the gas furnace only: heat in the products of combustion going up the stack and hot gases which escape from the furnace into the room. There is no simple way of calculating the latter; it can be estimated or lumped with other uncalculated losses by difference in a heat balance. (Figure 5)

★ ★ ★

As for stack escape heat: rather than go through involved calculations, Trinks, "Industrial Furnaces" was used as a reference and this value is taken from the graphs on City Gas. At 1750°F, assuming perfect combustion; that is, no excess air and 100% combustion, 40% of the heat available in the fuel goes up the stack. But perfect combustion does not exist and in reality between 45% and 50% of the heat available goes up the stack with the products of combustion. For this report it is assumed that 45% of the heat available was lost in this way.

★ ★ ★

Another loss theoretically common to both furnaces is radiation from the hot inner surfaces through the openings in the shell to the colder room. In the electric furnace such openings are virtually non-existent. For the gas unit the openings are large and numerous—burner ports, stack holes, etc. These losses are also lumped in the group that were not calculated, but found by a heat balance.

★ ★ ★

A pictorial representation of the heat balances of two furnaces when operating at 1750°F is shown in Figure 6. For this bar graph both furnaces are assumed to be running at the same load and the figures are adjusted accordingly.

Efficiencies

$$EFF = \frac{\text{Useful Energy of Furnace}}{\text{Energy Supplied to Furnace}}$$

where:

1. **Useful Energy has been calculated previously, this is the heat actually needed to anneal the wire.**
2. **Energy Supplied**
   a. **Electric Furnace = KW Hr. x 3415 btu/kw hr.**
   b. **Gas Furnace: = Cu Ft. Gas x 557 btu/cu ft. where 557 btu/cu ft. is the higher heating value of the City Gas supplied to the plant.**

★ ★ ★

When thermal efficiency is

(*Please turn to page* 1277)

Continuous Vulcanization of Butyl Insulated High Voltage Cable

by A. L. Rosener, Jr.
Process Development Engineer
John A. Roebling's Sons Corporation
Trenton, New Jersey

During the past twenty years, the demand for high voltage cable has increased rapidly. Rubber insulated and jacketed cables up through the 35,000 volt range have gained general acceptance largely because of the technological advances in this field. Better polymers and other raw materials are now available, compounding and processing techniques are steadily being improved, new and more efficient equipment is obtainable. As a result, rubber insulation is used along with Varnished Cambric and Impregnated Paper for High Voltage Cable; in addition, many new cable product constructions and applications are now possible. The advantages of rubber like material for cable insulation include greater flexibility and ease of splicing and terminating.

★ ★ ★

Probably the greatest strides have been made in the use of Butyl for high voltage insulation. When properly compounded, Butyl has outstanding electrical and physical properties plus excellent ozone resistance, heat resistance, moisture resistance and aging resistance.

★ ★ ★

Because of its heat resistance and its electrical stability, Butyl has been given a 90°C. rating for many applications. This is an indication of how a relatively new polymer can overcome some of the more serious limitations of the older general purpose rubber-like polymers.

★ ★ ★

High Voltage Butyl insulation, because of its low unsaturation and flow characteristics, is difficult to handle by old established wire and cable methods. New practices and specially designed equipment are required. However, when properly compounded, production and technical personnel no longer need to look upon Butyl as a troublesome special polymer that must be run only to satisfy some specification. On the contrary, Butyl has proved an incentive to the Electric Wire & Cable Industry for modernizing their plants and for the purchase of new equipment. Certainly new rules and rigid handling procedures must be established and enforced. However, once development and process problems have been overcome, new and improved practices result in producing more and better cables.

A paper prepared for presentation at the Annual Convention of The Wire Association in Chicago on October 15, 1957. The author received a degree in Chemical Engineering from Lehigh University in 1948. He served as Assistant to the Technical Superintendent of the Rome Plant of General Cable Corporation until 1951, when he joined the staff of his present company, where he is in charge of process engineering on rubber and rubber covered wire and cable.

A. L. Rosener, Jr.

★ ★ ★

For about twenty-five years, wire and cable companies have used the Continuous Vulcanization process for insulating and jacketing of small conductors and cords. The advantages of the C. V. process over Pan Tubing or Strip Insulating are many. Uniformity of product, elimination of handling of unvulcanized cable, reduced possibility of damage, less patching, longer continuous lengths, cleaner and less dusty plant, reduced manufacturing operations, and shorter delivery time, all result in improved product and reduced manufacturing cost. For example, two men on a large C.V. can complete in a single operation the five operations which formerly required eight to ten men in Pan Tubing.

★ ★ ★

Properly compounded Butyl insulation may be processed very satisfactorily by continuous vulcanization. With the high voltage cable manufacturing field becoming more competitive, the lower cost of C.V. becomes very attractive, especially since quality and efficiency can also be improved.

★ ★ ★

A decision to adopt the C.V. process for high voltage butyl insulation does not imply an immediate solution to all production and technical problems. In fact, many new and complicated problems arise.

★ ★ ★

The extrusion of a heavy wall of Butyl insulation in perfect balance with a take-up drive all regulated by required cure time in

a high pressure vulcanizing tube becomes an intricate mechanical and chemical engineering problem. See photograph.

A 500,000 CM Strand with 27/64" insulation, representing the large size and insulation wall that can be processed on the CV machine. This cable measured 1¾" outside diameter. * * * *

Butyl vulcanized under tape or lead in pans or on reel is normally cured at 40 to 50 pounds per square inch steam pressure. Cure times of one to three hours plus necessary pre-rise and post-cooling periods resulted in long and costly vulcanizing cycles for large sizes or heavy walls of conventionally tubed Butyl. C.V.'s operating in the range of 100 to 250 pounds per square inch steam pressure present a completely new problem.

★ ★ ★

Rate of heat transfer and rate of cure through thick walls are two major technical problems that can be resolved by basic engineering principles.

★ ★ ★

Many of the compounding ingredients and mixing techniques required to make a Butyl compound good electrically result in poor thermal conductivity. Coupling the slow heat transfer characteristics with the slow rate of cure of the Quinone type acceleration it appears that the C.V. cure time may be out of proportion from the commonly accepted Pan cure/C.V. cure time ratio.

★ ★ ★

To determine what happens when heavy walls of Butyl insulation on high voltage cables are cured in a C.V., a series of experiments were conducted using twenty-seven-sixty-fourths of an inch wall thickness of Butyl on various size conductors. This is the Insulated Power Cable Engineers Associated standard thickness for a 15,000 Volt ungrounded neutral cable.

★ ★ ★

Temperature measurements were obtained by inserting a thermocouple inside the strand of a 500,000 CM copper conductor in place of one of the inner wires. The conductor was spliced to an insulated leader of the same strand and insulated diameter. Four feet of conductor was insulated on a C.V. machine, then extruder and wire drive were stopped. Vulcanization was continued in the tube. The wire was stopped in order to eliminate error in recording thermocouple readings due to resistance of long lengths of the thermocouple wire.

★ ★ ★

Figure 1 shows a plot of Temperature in the copper conductor versus Time of Vulcanization in the steam tube at 225 pounds per square inch steam pressure (397°F.). This steam cure is represented by the solid line on Figure 1. The broken line, dashes, represents the cooling curve on the same specimen immersed in 60°F. circulating cooling water. The dotted line represents a similar experiment performed in an air oven at 392°F. using circulating air in place of steam.

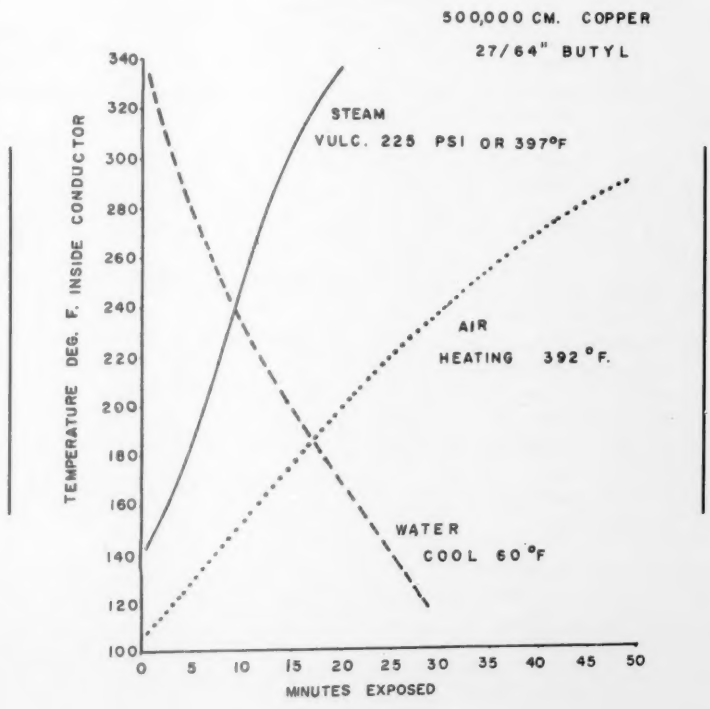
★ ★ ★

Rate of heat transfer and overall heat transfer coefficients may be calculated for the above decribed conditions by accepted Chemical Engineering methods.

★ ★ ★

The Specific Heat is 0.326 for the particular Butyl insulation used in this experiment, a typical ozone resistant high voltage compound. The Specific Heat depends on the chemical composition and quantities of the ingredients used, but is influenced by the degree of dispersion. Since the values for each ingredient have been published, a composite Specific Heat for the mixed compound can be calculated as an average over the temperature range of the experiment.

FIGURE 1



The temperature gradients measured vulcanizing in steam, and cooling in water were used to calculate an overall heat transfer coefficient for each case.

★ ★ ★

The heat transferred through the insulation per unit time in each case is a function of the Specific Heat, weight, and average temperature increase in the mass over the time of vulcanization or cooling. This relationship is expressed as:

$$q = C\ W\ \Delta\ T\ \frac{(60)}{(\theta)}$$

Where: q = B.T.U. per hour
C = Specific Heat
W = Weight of Matrial—Pounds per Foot
Δ T = Average temperature increase over heat transfer time °F.
θ = Time of heat transfer in minutes

★ ★ ★

The total heat transferred is the sum of the heat transferred to the rubber and the heat transferred to the conductor.

★ ★ ★

Once q is determined for each case, the overall heat transfer coefficients may be calculated as follows:

$$q = U\ A\ \Delta\ T_M$$

Where: q = B.T.U. per hour
U = Overall heat transfer coefficient B.T.U. per hour per sq. ft. per deg. F.
A = Logarithmic mean area between the inside and outside walls of the cylinder of insulation. Sq. ft.

$$A = \frac{A_1 - A_2}{2.3 \log \frac{A_1}{A_2}}$$

Where: A_1 = Outside Area
A_2 = Inside Area

ΔT_M = Logarithmic mean temperature difference (°F.) between the outside and inside walls of the cylinder at the start and finish of the vulcanizing or cooling cycle.

$$\Delta T_M = \frac{\Delta T_S - \Delta T_F}{2.3 \log \frac{T_S}{T_F}}$$

where: ΔT_S = T outside—T inside (start)
ΔT_F = T outside—T inside (finish)

For the experiments described above on the 500,000 CM cable with twenty-seven-sixty-fourths Butyl insulation the following overall heat transfer coefficients were calculated by this method:

1. Vulcanization in Steam at 225 pounds per square inch.
   U = 8.2 B.T.U. per hour per square foot per degree F.
   NOTE: See sample calculations.
2. Cooling in Water at 60°F.
   U = 8.5 B.T.U. per hour per square foot per degree F.

★ ★ ★

The overall heat transfer coefficient U is a function of the thermal conductivity of the insulation and the film coefficients. Vulcanization in steam results in surface condensation, and a water film is produced which accounts for the similar values of U for both Vulcanizing and Cooling. For air heating an extremely low gas film coefficient results, this together with poor mass contact account for the wide difference in slope between the Air Heating Curves and Steam Vulcanization Curves. For C.V. application, however, Steam Vulcanization and Water Cooling are the only pertinent values.

★ ★ ★

In addition to these thermal properties of the insulation, the cure characteristics of the Butyl compound should be determined before satisfactory continuous vulcanization is practicable.

★ ★ ★

The all important C.V. factor, time of cure penetration or full cure for thick walls, is directly proportional to the square of the thickness of insulation and to a function of the cure rate of the particular compound, but is in-

SAMPLE CALCULATIONS

Steam Vulcanization - Example:

Step No. 1 - Rate of Heat Transfer

$$q = C\ W \Delta\ T\ \frac{60}{\theta}$$

q = B.T.U. per hour for one foot of cable
C = Specific Heat
W = Weight per foot
Δ T = Avg. Increase in Temp. T_P (Avg.) - T_S = ΔT
θ = Time in minutes

for Butyl Insulation

$$q = .326\ (1.16)\ \left(\frac{397 + 300}{2} - 145\right)\ \frac{60}{14}$$

$$q = 330 \text{ B.T.U. per hour}$$

for Copper

$$q = .094\ (1.54)\ (300 - 145)\ \frac{60}{14}$$

$$q = 97 \text{ B.T.U. per hour}$$

Total: $q = 330 + 97 = 427$ B.T.U. per hour

Step No. 2 - Overall Heat Transfer Coefficient

$$q = U\ \bar{A}\ \Delta\ T_M$$

$$427 = U\ (.325)\ (162)$$

$$U = 8.2 \text{ B.T.U./Hr. ft.}^2 \text{ °F.}$$

$$\bar{A} = \frac{2\ \pi\ r_M}{12} = .325 \text{ sq. ft.}$$

$$r_M = \frac{r_1 - r_2}{2.3 \log \frac{r_2}{r_1}} = \frac{.875 - .425}{2.3 \log \frac{.875}{.425}}$$

$$\Delta T_M = \frac{\Delta T_S - \Delta T_F}{2.3 \log \frac{\Delta T_S}{\Delta T_F}} = 162°$$

where ΔT_S = 397° - 145°
ΔT_F = 397° - 300°

versely proportional to a function of the overall heat transfer coefficient and temperature differential between the extrusion temperature of the compound and the temperature at the time of complete cure. Mathematically this relationship may be expressed as:

$$\theta = \frac{f(K)\, t^2}{f^1(U)\triangle T}$$

where: θ = Time for full cure
$f(K)$ = Function of Cure Rate
t = Thickness of insulation
$f^1(U)$ = Function of the Overall heat transfer coefficient.
$\triangle T$ = Temperature rise in compound during cure

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In practice, this cure relationship is best determined experimentally by high pressure steam vulcanization of samples of the insulated cable over a range of times and steam pressures. Cure penetration measured from the outside at any time can be followed easily by examination of the cross section of the sample after exhausting the steam and water cooling.

★ ★ ★

Samples of No. 4/0 Strand with 27/64ths Butyl insulation were selected for this series of experiments. Two different Butyl compounds with a wide variation of cure rates were compared. The first compound contained a G.M.F., Red Lead, M.B.T.S. acceleration in 2, 6, 4 parts respectively per 100 parts of Butyl No. 035 polymer. The second compound contained a Di Benzo G.M.F., Red Lead, Sulfur acceleration in 6, 10, 1 parts respectively per 100 parts Butyl. The second combination is known to be much safer processing, but slower curing.

★ ★ ★

Figure 2 shows the cure penetration through the 27/64ths insulation graphically. There is a difference of from one to two minutes over the range plotted between times required for the two compounds to reach equivalent cures. At full cure this time difference amounts to less than 10%. To put it another way, for very heavy walls time of cure becomes more dependent on the overall heat transfer coefficient than on the cure rate. Conversely as wall thickness decreases, cure rate influences time of cure more and more.

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Figure 3 represents typical Mooney Cure Rate curves on both the first and second compounds showing the fast and slow accelerations. Base stocks themselves were not the same which accounts for Plasticity difference. From Figures 2 and 3 it is apparent that speed increase at C.V. is possible from faster acceleration, but this advantage is lost gradually as wall thickness increases, and any advantage gained in speed is naturally a sacrifice in processing safety.

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Physical properties of the insulation are affected considerably by the steam pressure maintained in the C.V. tube during cure.

★ ★ ★

Figures 4 and 5 show curves of Tensile Strength and 200% Modulus respectively vs Cure Time on the G.M.F:, Red Lead, M.B.T.S. compound vulcanized at 240, 200 and 150 pounds per square inch steam pressure. In this case a smaller strand, No. 1 with 27/64ths Butyl insulation was used. Physical tests were made on a slice of the outer surface of the insulation, one tenth of an inch thick, buffed smooth on both sides. Full cure was obtained through to

FIGURE 2

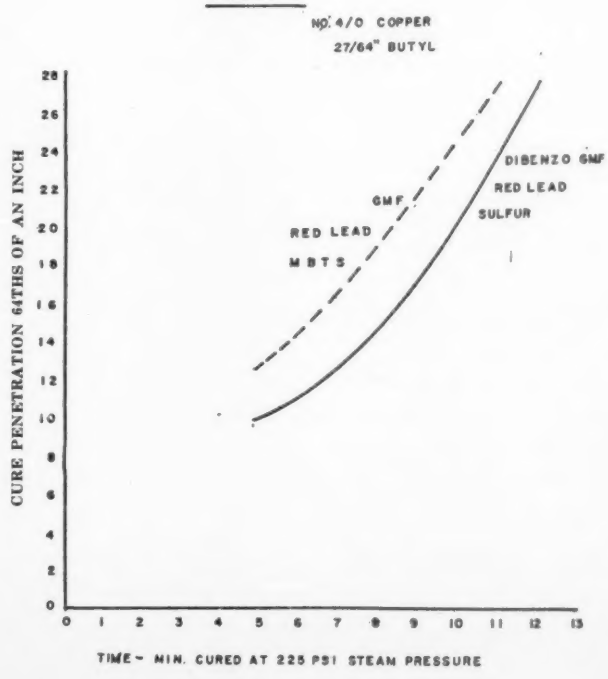


FIGURE 3

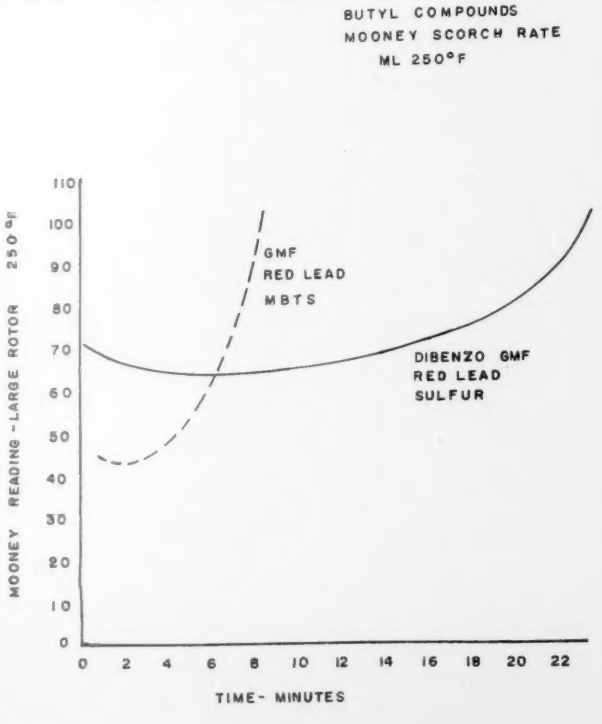


FIGURE 4

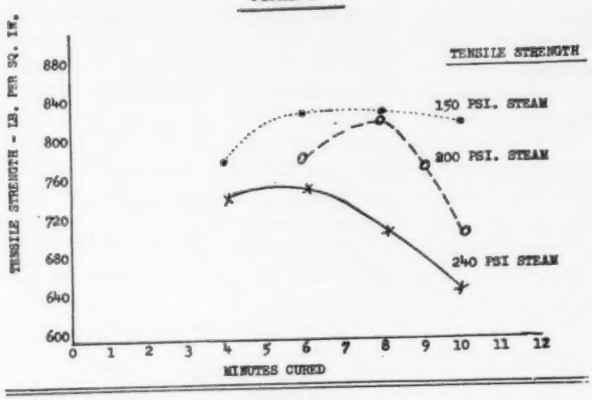
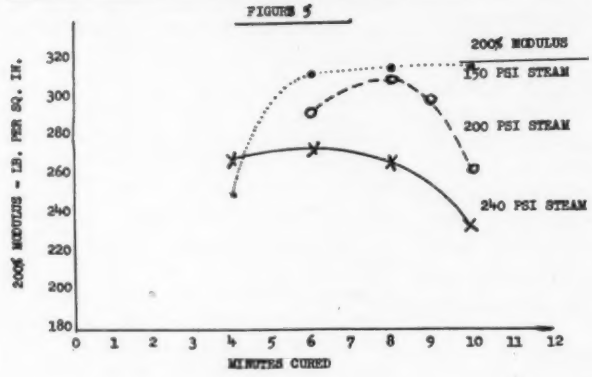


FIGURE 5



the conductor in 6 to 10 minutes depending on the steam pressure. However, on all tests made the cure was complete on the outer surface where samples were sliced. From Figures 4 and 5 it can be observed that both Tensile Strength and Modulus increase to an optimum, then drop off. Rate of decrease after optimum cure becomes greater as steam pressure is raised. Values of Tensile Strength and Modulus are also actually higher at reduced steam pressure. Accelerated aging tests as measured by per cent of Tensile Strength and Elongation values retained after aging in the air bomb for 20 hours at 126°C. and 80 pounds per square inch pressure show slighly better results at the higher steam pressure. See Table 1.

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The effect of cure penetration on physical properties may be seen from the data in Table 2 obtained from a sample of 500,000 CM cable with 27/64" Butyl using the Di Benzo G.M.F. acceleration. The outside samples were sliced and buffed from the outer one tenth of an inch of insulation, the inner samples from the one tenth of an inch next to the conductor. The middle samples were sliced half way in between the outside surface and the conductor.

(*Please turn to page* 1296)

TABLE I

PHYSICAL TEST DATA

No. 1 Strand - 27/64" Butyl Insulation *

	Minutes Cure 4'	6'	8'	9'	10'
240 lb. Steam Pressure					
Initial					
Tensile Strength - psi	745	760	707	--	652
200% Modulus - psi	267	274	267	--	235
Elongation - %	667	633	642	--	633
After 20 hour Air Bomb at 126 C.					
% Tensile Retained	87.7%	80.0%	80.7%	--	87.0%
% Elongation Retained	81.3%	79.0%	78.0%	--	85.6%
200 lb. Steam Pressure					
Initial					
Tensile Strength - psi	--	788	824	774	709
200% Modulus - psi	--	293	309	298	263
Elongation - %	--	667	675	658	642
After 20 hour Air Bomb at 126 C.					
% Tensile Retained	--	80.7%	73.6%	76.5%	83.0%
% Elongation Retained	--	77.5%	77.7%	79.7%	77.8%
150 lb. Steam Pressure					
Initial					
Tensile Strength - psi	785	833	830	--	820
200% Modulus - psi	249	312	312	--	315
Elongation - %	700	683	700	--	667
After 20 hour Air Bomb at 126 C.					
% Tensile Retained	83.2%	74.6%	73.5%	--	74.0%
% Elongation Retained	73.8%	76.8%	71.5%	--	76.2%

* NOTE: Acceleration
G.M.F. - 2 parts
Red Lead - 6 parts
M.B.T.S. - 4 parts

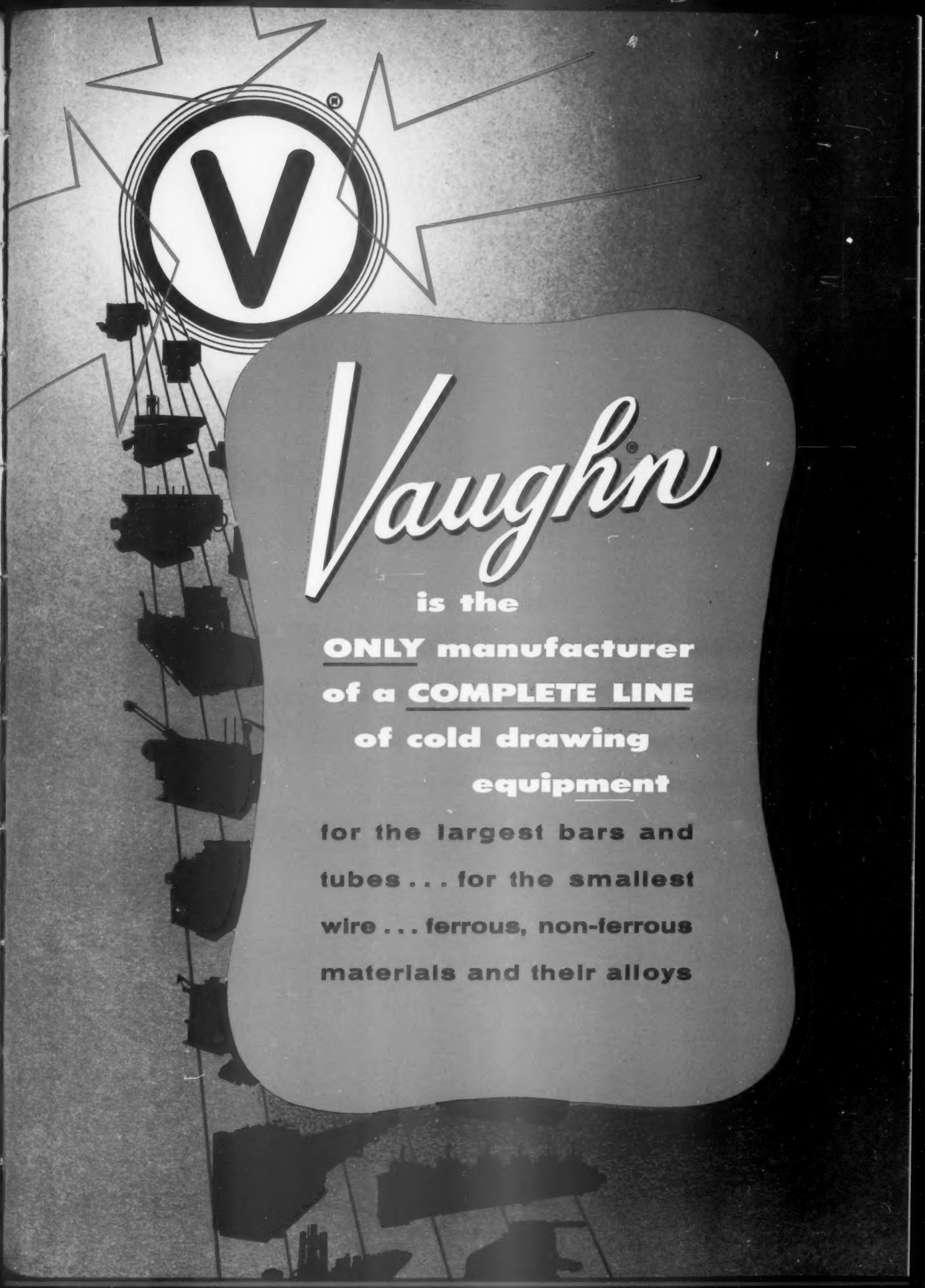
TABLE II

PHYSICAL TEST DATA

500,000 CM 27/64" Butyl Insulation *

	Outside Surface	Middle Section	Inner Surface
Initial			
Tensile Strength - psi	728	840	872
200% Modulus - psi	386	389	407
Elongation - %	525	545	537
After 20 hour Air Bomb at 126 C.			
% Tensile Retained	81.6%	68.0%	63.1%
% Elongation Retained	80.0%	79.4%	62.0%

* NOTE: Acceleration
Di Benzo GMF - 6 parts
Red Lead - 10 parts
Sulfur - 1 part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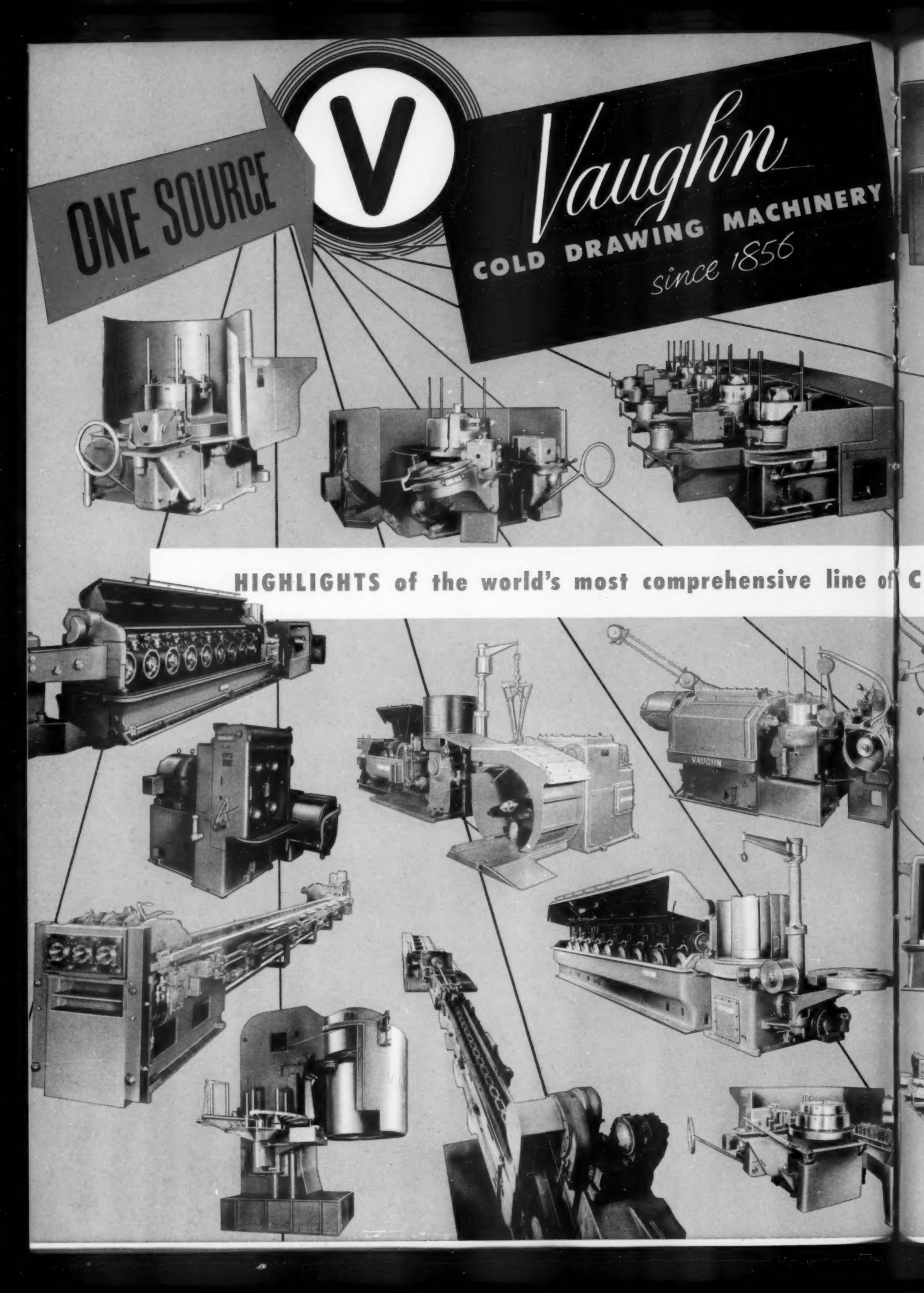
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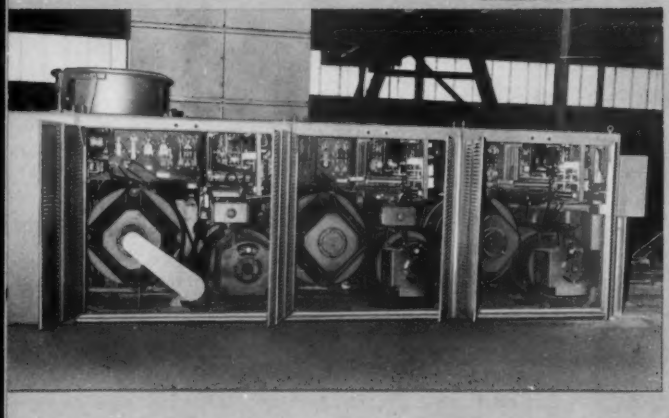

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COMPLETE COLD DRAWING EQUIPMENT—Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys

Stainless Steel Cold Heading Wire

By S. E. Tyson
Metallurgist, Stainless Steels
The Carpenter Steel Company
Reading, Pennsylvania

Stainless steels continue to enjoy a wider acceptance for cold headed parts. This group of alloys satisfies several needs—corrosion resistance, high strength at room and elevated temperatures, and many of those fasteners which must meet the stringent qualifications of the aircraft industry. A number of grades can be cold headed profitably. They vary in both corrosion resistance, cold headability, and, like carbon and alloy steels, in mechanical properties. Thus, unless one is manufacturing parts to a specification, it becomes necessary to become familiar with the properties of the various headable stainless steels in order to make the proper choice.

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The purpose of this presentation is to describe the experience of **The Carpenter Steel Company** in supplying stainless steel cold heading wire that has met the demands of the cold heading industry. The experience and recommendations to be presented are purely metallurgical; that is, they concern the metallurgical aspects of manufacturing and heading techniques that promote the successful cold heading of stainless wire. The operation of heading machinery and the design of headed parts are not within the scope of this article —recognition of the competence of the manufacturers of cold headed parts has been justly acknowledged. For simplification, the stages in producing sound headed parts for a particular application will be defined as follows:

1. **Selection of analysis**
2. **Wire mill processing**
3. **Cold heading operation**

In cold heading stainless steels there are two basic problems common to all metal forming operations. The metal being worked (the wire) must be able to be formed without rupture and the forming tools (header dies, punches, etc.) must not wear prematurely, crack or chip. Failure of the wire, resulting in split heads or compression cracks, obviously means rejected parts. Short tool life leads to prohibitive operating costs. These two subjects should be borne in mind throughout this presentation.

S. E. Tyson

A paper prepared for presentation at the Annual Convention of The Wire Association in Chicago on October 16, 1957.

The author graduated from Pennsylvania State University in 1948 and in that year joined Carpenter Steel as a laboratory assistant. Later he was made wire mill metallurgist, a position he held for a number of years, until appointed to his present post as Metallurgist, Stainless Steels. He is a member of the American Society for Metals, the American Society of Corrosion Engineers and The Wire Association.

Selection of Analysis

Choice of the proper grade of stainless steel for cold heading must be based upon two factors: corrosion resistance and cold headability. Figure No. 1 is a schematic diagram showing the relative headability and corrosion resistance of the popular cold headed grades. In Table No. 1 will be

Table No. I

	C Max.	Mn Max.	P Max.	S Max.	Si Max.	Cr	Ni	Mo	Misc.
AISI Type 410	.15	1.00	.040	.030	1.00	11.50/13.50			
AISI Type 430	.12	1.00	.040	.030	1.00	14.00/18.00			
AISI Type 431	.20	1.00	.040	.030	1.00	15.00/17.00	1.25/2.50		
AISI Type 440-C	.95/1.20	1.00	.040	.030	1.00	16.00/18.00		.75 max.	
Greek Ascoloy	.15/.20	.50	.040	.030	.50	12.00/14.00	1.80/2.20	.50 max.	2.50/3.50 W
AISI Type 304	.08	2.00	.045	.030	1.00	18.00/20.00	8.00/11.00		
AISI Type 305	.12	2.00	.045	.030	1.00	17.00/19.00	10.00/13.00		
AISI Type 316	.08	2.00	.045	.030	1.00	16.00/18.00	10.00/14.00	2.00/3.00	
AISI Type 347	.08	2.00	.045	.030	1.00	17.00/19.00	9.00/13.00		10×% Cmin Cb-Ta
Carpenter No. 10	.08	2.00	.045	.030	1.00	15.00/17.00	17.00/19.00		
Carpenter No. 20	.08	2.00	.045	.030	1.00	19.00/21.00	24.00/30.00	2.00/3.00	3.00/4.00 Cu
A-286	.08	1.00/2.00	.040	.030	.40/1.00	13.50/16.00	24.00/27.00	1.00/1.50	1.75/2.25 T .10/.50 V .35 max. Al

Certain of the AISI grades are held to special close analysis limits for better cold headability.

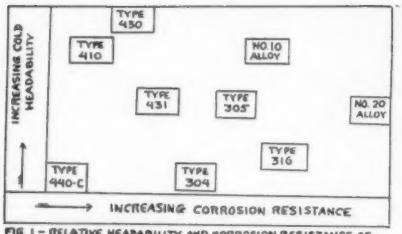

FIG. 1 - RELATIVE HEADABILITY AND CORROSION RESISTANCE OF STAINLESS STEELS

found the analyses of those grades mentioned herein. Although very slight cold upsetting operations can be performed with the free machining stainless steels, they are not generally considered for cold headed parts. Some alloys find limited application for cold heading since they are generally welded when used for joining. These include Type 347, used for service involving temperatures above 800°F., and Types 309, 310 and 330, which exhibit good high temperature scale resistance. The A-286 alloy is finding increasing popularity for corrosion resistance with high temperature strength up to 1300°F.

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Types 410 and 440-C are straight chromium grades with moderate corrosion resistance and capable of being heat treated similarly to carbon and alloy steels. They resist corrodents such as the atmosphere, fresh water, perspiration, foodstuffs, soap and other mild corrosives.

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Type 431 offers the best corrosion resistance of all the hardenable grades and is finding increasing use for aircraft applications because of resistance to marine atmospheres. The most popular grade is Type 430, an alloy with excellent headability and good atmospheric corrosion resistance. Although it exhibits fairly good strength, it cannot be hardened appreciably either by heat treatment or cold work.

★ ★ ★

The austenitic grades which contain over 16% chromium and over 7% nickel have much better corrosion resistance than either the hardenable or non hardenable straight chromium steels. The 18-8 types, No. 304 and 305, are about equal in corrosion resistance and can be used to resist atmospheric corrosion as well as foodstuffs, nitric acid, most organic chemicals and many inorganic chemicals. Carpenter Stainless No. 10, a special alloy developed specifically for cold headed parts, has better corrosion resistance than Type 304 in many applications. Type 316, a molybdenum-bearing chromium-nickel steel, has superior corrosion resistance because of the molybdenum addition and is used for corrosive environments such as phosphoric and acetic acids. It has considerable usage in equipment for the chemical processing industries. The most corrosion resistant stainless grade available for cold headed parts is Carpenter No. 20 which exhibits good resistance to hot sulphuric, phosphoric, nitric and all the organic acids. Each specific problem in corrosion involves many complex variables such as temperature, concentration, aeration, etc. so it is recommended that actual field tests be made before selecting the grade of stainless steel to be used in critical assemblies.

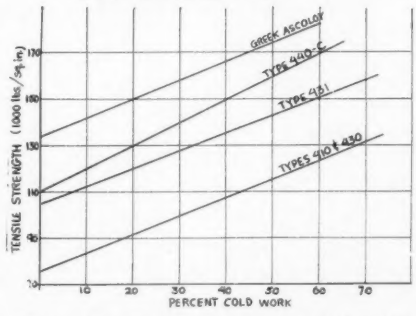
★ ★ ★

The mechanical properties of these alloys are listed in Table No. 2. These data are for annealed material and were obtained from sections larger than wire so that a complete list of properties could be obtained. Most cold heading wire will be somewhat harder as supplied because of the light final draft. Only the hardest materials are furnished dead soft annealed.

★ ★ ★

The work-hardening rates of the stainless steels are an indication of their relative cold headability. Those showing the least increase in hardening per given degree of cold work will require less work to form them and, thus, less tool wear. Figures Nos. 2 and 3 illustrate the increase in tensile strength versus percentage of cold work, the latter determined as reduction in area by wire drawing.

FIG. 2 - WORK HARDENING OF FERRITIC AND MARTENSITIC STAINLESS STEELS



Note the family of curves for the martensitic and ferritic grades. The work-hardening rates are parallel and thus equal but the annealed strengths differ. (Greek Ascoloy, a high temperature alloy has been included with this group.) With these alloys, it is the as-annealed strength (some with exceptionally high yield strengths) which determines cold headability.

Table No. 2

Average Mechanical Properties —Annealed Condition

	Yield Strength (0.2% off-set, psi.)	Ultimate Tensile Strength (psi.)	Elongation (per cent in 2")	Reduction in Area (per cent)	Izod Impact (V-notch, ft-lb)	Hardness (Brinell)	Hardness (Rockwell)
AISI Type 410[1]	40,000	75,000	35.0	70.0	90	155	B82
AISI Type 430[1]	45,000	75,000	30.0	65.0	—	155	B82
AISI Type 431[2]	90,000	110,000	20.0	55.0	55	235	C21
AISI Type 440-C[1]	65,000	110,000	15.0	30.0	—	250	C35
Greek Ascoloy[1]	110,000	135,000	18.0	54.0	—	283	C30
AISI Type 304[3]	35,000	85,000	60.0	70.0	110	150	B81
AISI Type 305[3]	36,000	82,000	56.0	73.0	110	140	B76
AISI Type 316[3]	30,000	85,000	60.0	70.0	110	150	B81
AISI Type 347[3]	35,000	90,000	50.0	65.0	110	160	B84
Carpenter No. 10[3] ...	35,000	80,000	55.0	75.0	110	130	B72
Carpenter No. 20[3] ...	35,000	85,000	50.0	65.0	110	150	B81
A-286[3]	37,000	90,000	50.0	70.0	100	160	B85

[1] Martensitic type structure.
[2] Ferritic type structure.
[3] Austenitic type structure.

FIG. 3
WORK HARDENING OF AUSTENITIC STAINLESS STEELS

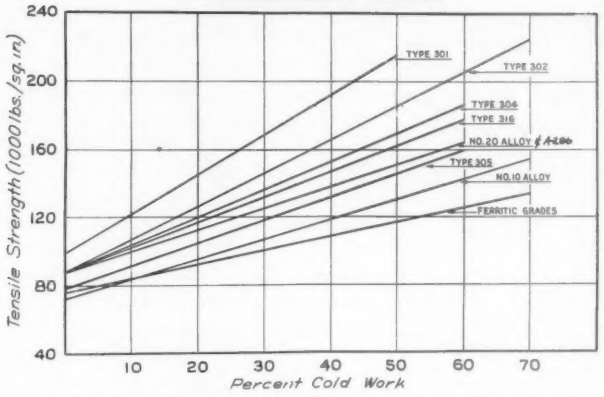


FIG. 4

For example, Type 431 exhibits a yield strength exceeding 90,000 psi which is more than twice that of most austenitic grades. This means the header must exert twice the force for initial deformation. It has been found extremely difficult to head these alloys successfully at tensile strength levels above 140,000 psi.

★ ★ ★

Referring to the austenitic grades on Figure No. 3, note that while Type 305 exhibits a much lower work-hardening rate than Types 304 and 316, the No. 10 alloy shows an even lower work-hardening rate, only slightly above the ferritic grades such as Type 430. The AISI Types 301 and 302 and a general curve for the ferritic stainless grades have been included for comparison.

★ ★ ★

If the corrosion resistance of the regular 18-8 types are sufficient, then selection depends on headability. Type 304, the basic austenitic stainless steel, is only suitable for the least severe cold heading operations. The resistance to cold working of Type 304, from the standpoint of tool life alone, makes severe cold forming operations impractical. Type 305 is the choice for many headed parts including those produced by two stage heading procedures as well as other severely upset shapes. Both Type 316 and the No. 20 alloy compare favorably with Type 305 with regard to headability. Carpenter Stainless No. 10 is the first austenitic stainless grade engineered specifically for making recessed head screws, the manufacture of which once involved excessive tooling costs.

★ ★ ★

Analysis determines the work-hardening rate of the austenitic stainless steels. About the most important single element in the analyses of these grades is nickel. As the nickel content is increased, the austenitic structure becomes more stable, that is, the higher nickel grades have less tendency to become magnetic with increasing amounts of cold work. The increase in magnetism is an indication of the increase in hardness or strength which results from cold working. By making the austenitic grades more stable, the increase in hardness due to the working is decreased. For example, Type 305 and the No. 10 alloy are increasingly more stable than Type 304. The most stable alloy, No. 10, does not become magnetic and therefore work-hardens the least, enabling a reduction of tool wear and punch breakage. This property of the No. 10 alloy is mentioned because there are applications for cold formed parts requiring very low magnetic permeabilities.

★ ★ ★

From the standpoint of the producer, of equal importance with proper analysis control, is inspection of billets for internal soundness. There have been occasions of split heads on critical head designs arising from internal nonmetallic inclusions. To safeguard against this, a rigid inspection must be placed at the billet stage before the coils are hot rolled. With proper inspection procedures, wire with adequate internal soundness may be assured.

Wire Mill Processing

It has been found that the best cold heading wire, irregardless of the analysis, is produced by annealing to a dead soft condition at a size slightly larger than the finished size. After this, the wire is specially coated for lubrication and cold drawn to the finished size. This processing results in a combination of the lowest possible hardness with a certain amount of stiffness in the wire for smooth feeding into a cold heading machine. Cold drawn wire will pay off into a heading machine much better than wire which has been annealed last. The light final draft produces a coil which contains no kinks, bends nor tangled strands which could cause jamming while the wire is being fed into the heading machine. Lightly drafted wire also has been found to have better shearing properties than dead soft material; the latter has a tendency to be flattened at the shear cut. Furthermore, the final draft enables the manufacturer of the wire to apply some extra coating for lubrication during the heading process.

★ ★ ★

Through years of experience it has been found that the best general coating for the cold heading of austenitic stainless wire is one consisting of a copper plate plus lubrication applied during the final drafting operation. The copper plating operation presents some difficulties since stainless steels naturally possess a chemically passive surface film which tends to resist adhesion of plated coatings. Precise control of the plating and preceding cleaning operations are necessary in order to obtain a uniform and tightly adherent cop-

per coating. The thickness of the copper coating need be only a few tenths of a mil. The purpose of the copper coat is merely that of preventing the stainless steel from coming in contact with the cold heading dies. The prime requisite of the copper coating is good adherence; poorly prepared wire will exhibit a tendency for the copper to flake off and be useless.

★ ★ ★

Following the plating operation, the wire is coated with a carrier such as lime which serves two purposes. The carrier drags the wire drawing lubricant through the die during the final draft. It also provides extra separation between the wire and the header dies. During the final draft to the finished wire size special lubricants are used depending on the type of wire and the cold heading operation. For example, sodium stearate soaps may be used for Type 430 wire but aluminum stearate and special waxes must be used for the more difficult to head alloys. Soaps with higher melting points must be used for more severe heading operations. One of the most difficult products to make is Type 431 bolts with extruded shanks for roll threading. For best results wire should be coated for the job. Coatings for extrusion may be too heavy and clog dies resulting in poor tolerance control on delicate head designs. Coatings for regular heading may be insufficient for extrusion.

★ ★ ★

The seam depth of stainless heading wire should usually be limited to approximately .002/.003". Shallower seam depth must be maintained with relatively fine wire whereas very large diameter wire may contain proportionately deeper seams. Experience has shown that stainless wire can be successfully cold headed even to recessed heads of the truss head design if seam depths are thus restricted.

★ ★ ★

The consumer usually specifies the method of packaging coils of cold heading wire. Waterproof paper wrapping is common and coils are either shipped loose or in bundles which can be handled by a lift truck. Careful handling and bracing for shipment are necessary if kinked strands of wire are to be avoided. Nicked and kinked wire is always a possible source of trouble for the heading machine operator.

The Cold Heading Operation

The first stage in cold heading is the shearing operation. At this point it is most important to obtain a good clean shear without tears, etc., which could cause the development of cracks during the actual heading operation. Proper clearances of the cutting edges as well as sharp tools are prerequisites of good shearing. Willis points out the important factors regarding shearability; see reference No. 3. Tool steel selection and heat treatment of the tools are equally important.

★ ★ ★

For two-stage heading operations, the development of the blank (the first stage in a multistage heading operation) is metallurgically quite important. In all stages of heading the head must remain concentric — many cases of cracked heads have resulted from non-concentricity during the first stages of the heading operation. This is very important, for eccentricity will cause extremely high stresses on certain portions of the head, resulting in compression cracks. There are a number of cases on record where a troublesome heading job was made routine simply by properly lining up the dies.

★ ★ ★

Head design is a matter which possibly cannot be changed; however, it is in order to point out some of the difficulties encountered in making various designs. Wistreich has given an excellent discussion of the influence of head design upon cold headability. Figure No. 4 illustrates strain patterns arising from the cold heading of several basic head designs. That the degree of local deformation of the cold worked metal depends on the shape of the headed part is clearly shown. Round heads are more subject to stress cracks than are other head shapes.

★ ★ ★

As an example of paying attention to some minor details in head design, we have found that some critical heads can be fabricated successfully if stresses are minimized by not forming the metal into sharp corners. For example, see Figure No. 5. This shows a particular slotted head screw which cracked during heading when formed with sharp edges on the head. Another machine setup, which eliminated the sharp edges, successfully headed the same wire. The stress level in the head was lowered by avoiding the complete filling of the die cavity.

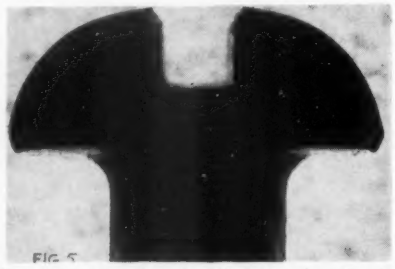


Fig. 5

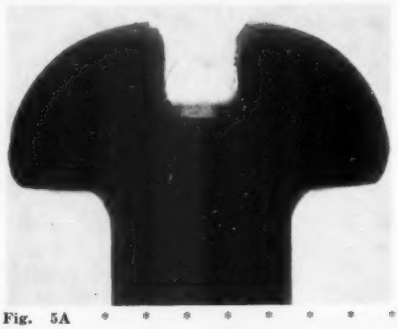
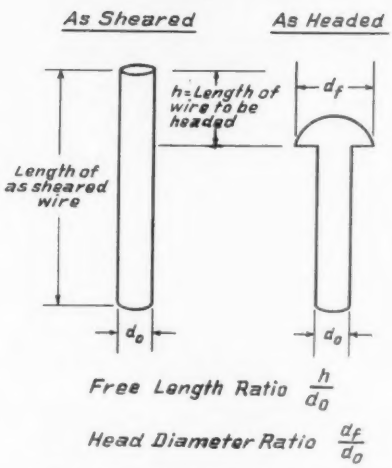


Fig. 5A

The severity of a cold heading operation can be measured both in terms of the head diameter ratio and by what shall be called the free length ratio. To avoid any possible confusion, an illustration of how these ratios are calculated is shown in Figure No. 6. The head diameter ratio indicates the degree of spreading which occurs during heading. It is generally recognized that a head diameter ratio of three to one is a severe cold heading operation. Of course, head design must be considered at the same time. Nevertheless, very slight changes in head diameter ratio can produce significant results.

FIG. 6
DEFINITION OF HEADABILITY PARAMETERS



As an example of how critical head diameter ratio can be, it was possible for one screw manufacturer to eliminate compression cracks in a truss recessed head design by reducing the head diameter ratio from 2.87 to 2.74 with a switch from a No. 10 to a No. 9 head. One note of caution: the head diameter ratio for recessed heads must exceed a minimum ratio to prevent the punch from splitting the heads. Too large a punch size in relation to the head diameter will result in split heads.

★ ★ ★

The free length ratio is important because it indicates the length of wire which must be upset. High free length ratios may result in heading difficulties because of the tendency of the free stock to buckle, producing an eccentric blank. Free length ratios exceeding four are difficult jobs but experience has shown that recessed heads can be headed from the No. 10 alloy with higher free length ratios when special techniques are employed.

★ ★ ★

Unless special precautions are taken a free length ratio exceeding 2¼ cannot be upset in one blow. Higher ratios will result in bending the wire instead of simply upsetting. By using special tooling, such as a floating die or spring loaded punch, it is possible to upset several times the theoretical minimum length in a single blow.

★ ★ ★

These special dies expose a free length of wire less than the critical 2¼ free length ratio while the wire is being expanded into the head. (The die receives the free end of the wire and slides back exposing additional wire as the head is formed from previously exposed wire.) Even with this ingenious arrangement the dies must be properly aligned to prevent the formation of eccentric heads and resulting compression cracks.

★ ★ ★

Definite limiting values cannot be assigned to head diameter and free length ratios. It is important to consider both ratios when examining the severity of any heading operation. For example, Figure No. 7 indicates the degree of spreading the No. 10 alloy will take. This shows .490″ diameter wire which was upset to a head diameter ratio of 2.75 while the free length ratio was merely 1.2.

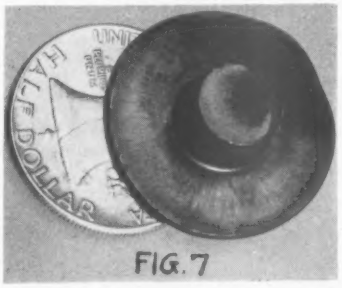


FIG. 7

It becomes evident that higher head diameter ratios become more critical when the free length ratio decreases. Within safe limits of these ratios a high h/d_f ratio is less difficult to head than a high d_f/h.

Some studies have been made on the effect of the speed of the heading operation. Messrs. Baldwin and Beiser have indicated that austenitic stainless steels have an increasing tendency towards cracking as the heading speed is increased. Experiences with steels like Type 305 and the No. 10 alloy have shown that there is not much benefit to be gained by using slower heading speeds where there are compression cracks forming during the cold heading operation. Proper control of the other factors will usually permit successful heading of these steels at the operating speeds of present machinery.

★ ★ ★

Tool life is of primary importance when manufacturing recessed head screws. The lowest priced grade of stainless wire will not necessarily result in the lowest cost headed parts because of this factor. Heading Type 304 stainless wire has resulted in a considerable number of broken punches and excessive machine down time. Type 305 offers much improvement, but the No. 10 alloy has made possible 25% longer tool life than that obtained when heading Type 305. The needs for lower tooling costs and less machine down time were the chief reasons for creating austenitic stainless steels with lower work-hardening rates.

★ ★ ★

Another case wherein excessive tool wear and breakage have been eliminated is in the production of stainless steel nuts by cold heading. Once considered impractical this has been accomplished by using the No. 10 alloy with its lower work-hardening rate. Figure

(*Please turn to page* 1248)

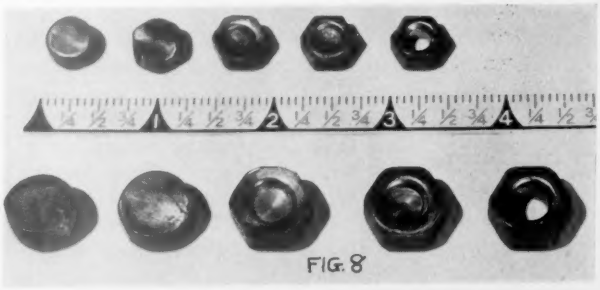
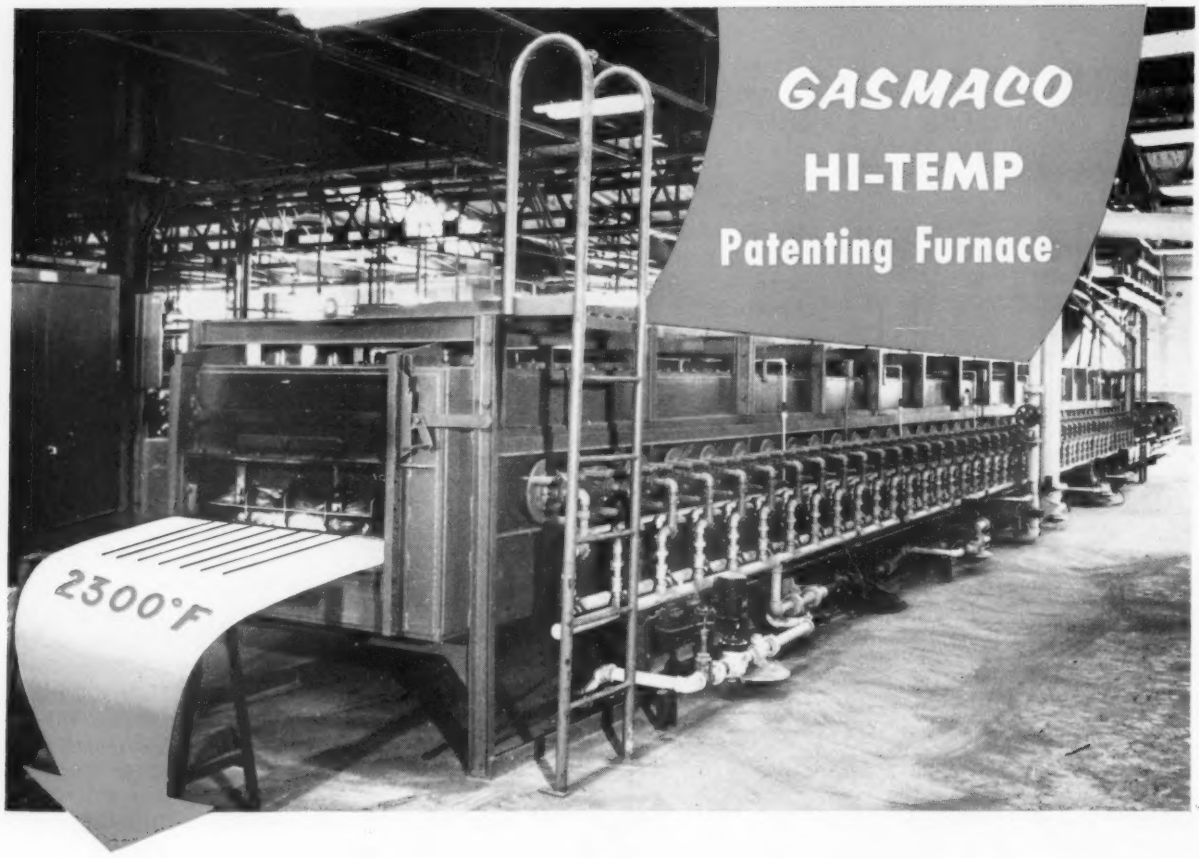


FIG. 8



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Plating Wire for Eye Appeal

by O. B. Lusk
Chief Inspector
United Steel and Wire Company
Battle Creek, Michigan

My part in this discussion of "Plating Wire for Eye-Appeal" is to discuss this matter from the viewpoint of one who converts the plain wire as it is received from the mill into the finished product ready for delivery to the purchaser's factory. In fact, our work is on trial until the oven rack, refrigerator shelf, fan guard, or grocery cart is finally placed in use by the ultimate user.

★ ★ ★

These users are not technicians. They are buying an article first, because it is necessary and useful, secondly, because of appearance. This matter of appearance is based on two principal items, design and finish. In a great many instances finish will be a more dominant factor in selection than will design.

★ ★ ★

To the end that our fabricated wire products would have greater eye-appeal we have utilized a number of finishes in the past. Among these are several which were plated by the wire manufacturer. Included are copper plate, tin plate and zinc or galvanized wire. Tin and zinc have each been applied by electro-plating and immersion in molten metal. In our own plant we have applied hot dipped tin, hot dipped tin with electro-deposit of copper, nickel, and chrome plus lacquer. The last two finishes due to rising material and labor costs are no longer used by us although they are in my opinion, very good, both from the standpoint of eye-appeal and corrosion resistance.

★ ★ ★

Electro - plated products give good results, both from the standpoint of corrosion resistance and eye-appeal when properly applied. In order to apply these finishes properly the wire must be of a quality to do the best possible job.

O. B. Lusk

This paper, prepared for presentation as a part of the Symposium on Wire Plating at the Annual Convention of The Wire Association in Chicago on October 14, 1957, treats of plating from the standpoint of the plant that plates plain wire for product fabrication.

★ ★ ★

The selection of any one of the preceding finishes is dependent upon various factors such as appearance, corrosion resistance, whether it is severe or mild, indoor and outdoor use, and customer's specification. Some of our customers maintain laboratories which enable them to determine for themselves, the type of plating and thickness required.

★ ★ ★

All of the electro-plated finishes are dependent for their appearance on the surface of the wire on which they are applied. This is particularly true in finishes which have a bright lustrous finish. Plating is not thick enough to cover defects in the surface, nor are we able to nickel buff as is done on ferrous automotive parts. The most common faults in wire, encountered in our products, are piping, porous surface, scale inclusion, and unfilled dies.

★ ★ ★

There are, as you know, two major divisions of wire from which welded wire products are made. These are bright hard basic and extra clean bright hard basic. All wire used in our production must be free from slivers, piping or flaking. Slivering, or flaking even in a small degree constitutes a real hazard. We have had damage suits resulting from cuts caused by these defects. Naturally every cut so caused results in the loss of about four gallons of blood, and an acre of skin by the time the information reaches us.

★ ★ ★

Extra clean bright hard wire is the grade most generally used for plating where appearance is of major importance. In either grade, however, we must receive wire which is free from rust and excess dirt.

★ ★ ★

In order to protect this surface from rust it is necessary that this wire be oiled at the mill with a light mineral oil easily removed in our cleaning process. Cars or trucks used in transporting this material should be clean. This seems an obvious fact, but we do occasionally receive wire in such condition that it is necessary to clean the wire before using which results in expense and inconvenience to the user.

★ ★ ★

Mr. Corson believed it would be of interest to you to know something of the plating process from fabricated part to the final operation of plating, so here in brief is

the cycle of operations involved in copper-nickel-chrome plating.

★ ★ ★

1st Operation—Cleaning.

★ ★ ★

6 to 8 ounces of alkaline cleaner per gallon is used. The temperature of the solution is maintained by thermostatic control between 160 degrees to 180 degrees Fahrenheit.

★ ★ ★

Reverse current 6-8 V 150 amps per square foot is used in this solution in order to remove the grease and dirt from the work. The mineral oil is emulsified in this solution which enables the residual dirt to be easily rinsed off after removal from this tank. Cleaning cycle time is approximately four minutes.

★ ★ ★

2nd Operation—One minute rinse in cold running water.

★ ★ ★

3rd Operation—1st pickle.

★ ★ ★

This operation consists of a 50% by volume of muriatic acid for three minutes at room temperature. No current is used.

★ ★ ★

4th Operation—Double rinse in cold running water, approximately two minutes.

★ ★ ★

5th Operation—Second cleaner.

★ ★ ★

This is a 6 to 8 oz. low voltage reverse current cleaner maintained at 170 degrees to 180 degrees Fahrenheit, thermostatically controlled with a time cycle of three minutes.

★ ★ ★

6th Operation—Rinse in cold running water for one minute.

★ ★ ★

7th Operation—Second pickle.

★ ★ ★

This is a 50% by volume, cold muriatic rinse for two minutes with no current. Besides an extra cleaning this solution removes carbon smut caused by the freeing of carbon-particles left on the surface of the steel in the first pickle. Metal should now be bright and clean.

★ ★ ★

8th Operation—Double rinse in cold water for two minutes.

★ ★ ★

9th Operation—Copper coat.

★ ★ ★

This copper plate solution is a 3½ to 4½ oz. per gallon of copper with free cyanide present in the amount of 1½ oz per gallon. Caustic is present in the amount required to maintain a Ph reading of 12.5/13. This solution is maintained thermostatically at a temperature of 140 degrees Fahrenheit with a permissible variation of plus or minus 2 degrees.

★ ★ ★

This is a direct current solution 4-5 V. at about 10 amperes per square foot. This amperage is changed according to requirements. A five minute plating cycle deposits approximately .0001" of copper on the work. Copper cyanide content is checked daily. The free cyanide and caustic are checked each shift to maintain proper balance. The purpose of the free cyanide is to prevent burning and treeing. It also helps maintain evenness of plating thickness. The caustic is necessary to increase conductivity.

★ ★ ★

10th Operation—This operation consists of two cold water rinses of about one minute each.

★ ★ ★

11th Operation—Nickel plate solution.

★ ★ ★

Nickel chloride in the amount of 30 oz. per gallon with nickel present in the amount of 10 oz. per gallon as pure metal is used in our solution.

★ ★ ★

This solution is maintained at a temperature of 135 degrees to 140 degrees Fahrenheit by thermostatic control. Direct current at 60 to 70 amperes per square foot is used in this bath, which is air agitated to aid in faster, more efficient operation. We use the Udylite nickel. Boric-acid used in this bath helps level the plating thickness and also maintains the solution in a slightly acid condition.

★ ★ ★

These nickel anodes are placed in pure cotton bags and are hung vertically from the sides of the tank. These cotton bags are to filter out the minute impurities present in the anodes.

★ ★ ★

12th Operation—Rinse.

★ ★ ★

This operation consists of one minute rinse in cold running water followed by two minutes of spray rinse. It is very necessary that this operation be well done as improper rinsing here will result in dulling or blistering of the chrome which is next applied.

★ ★ ★

13th Operation—Chrome plate.

★ ★ ★

This is a five minute cycle in a 48-50 oz./gallon of chromic acid. Sulphuric acid is added to the solution and is maintained at a ratio of 125 parts of chromic acid to one part of sulphuric acid.

★ ★ ★

The temperature of this solution is 105 degrees Fahrenheit, thermostatically controlled. This temperature is in the range of most efficient operation. Too low a temperature results in burning of the chrome. Too high a temperature results in lower efficiency. The operation just described results in the application of approximately .00001" thickness of chrome plate.

★ ★ ★

14th Operation—Rinsing.

★ ★ ★

This operation consists of two, one minute immersions in cold running water, followed by a one minute immersion in lukewarm water.

(*Please turn to page* 1264)

A Simplified System for Carbon Restoration

by John Arnold, Chief Engineer
Lee Wilson Engineering Company, Inc.
Cleveland, Ohio

During the last ten to fifteen years, the advance in the use of protective atmospheres in the annealing of steel in rod, wire and bar form has been outstanding. The industry has advanced to the general use of the low ratio exothermic type generator for bright annealing of low carbon steels, and to the nitrogen type generator for decarb-free annealing of low and medium carbon steels. For high carbon steel, dissociated ammonia and endothermic type generators are in widespread use.

★ ★ ★

Normally, the hot rolled bar stock and rod in use today contain varying amounts of total and partial decarburization. The gases previously mentioned, with the exception of the endothermic gases, are able to contain only the carbon content of the steel as it exists in the as-rolled condition. During more recent years, the demand for better quality steels has increased. This trend in industry for better quality steel has led to the use of protective atmospheres, during the annealing cycle, for the restoration of carbon in steels that have been decarburized either in hot rolling, or heating operations prior to annealing.

★ ★ ★

There are apparently two trends of thought as to the correct method of restoring carbon to steel. These two methods vary only in the type of gases used and the equipment with which the gases are used.

★ ★ ★

Diagram #1 shows the schematic layout of the two carbon restoration systems. System #1 shows the schematic layout of a nitrogen generator, refrigerant gas dryer, a desiccant gas dryer, a mixing station for controlling and

John Arnold

A paper prepared for presentation at the Annual Convention of The Wire Association in Chicago on October 15, 1957.

mixing dry nitrogen gas, wet nitrogen gas and natural gas, prior to entering the furnace unit. It also shows a Ranarex specific gravity indicator, a pressure manometer, and a dew point recorder, recording the exhaust gas dew point from the furnace. System #2 shows the layout for a nitrogen generator, refrigerant gas dryer, desiccant gas dryer, an endothermic type generator, with dew point recorder and controller and availability of mixing additional natural gas to the system prior to entering the furnace. System #2, using the endothermic type gas generator, has been explained in detail on a number of occasions. This particular system is used primarily with continuous type furnaces and has been used occasionally on batch type furnaces.

★ ★ ★

System #1, using nitrogen gas as a carrier gas and enriched with natural gas, is the system we will discuss in this paper.

★ ★ ★

Using this method of carbon restoration, successful restoration cycles have been carried out in rectangular car bell type furnaces using sand and oil seals as shown

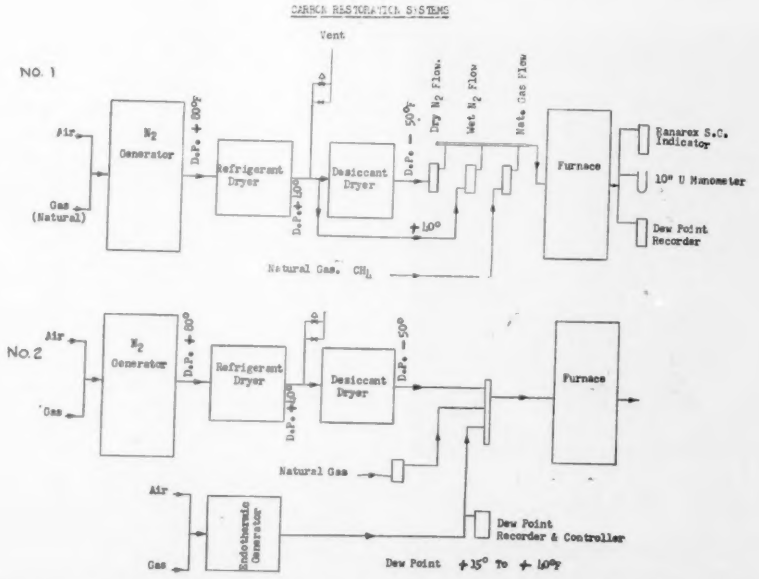


Diagram 1—Carbon restoration systems.

Fig. 1. Merchant Bar and coil annealing furnace.

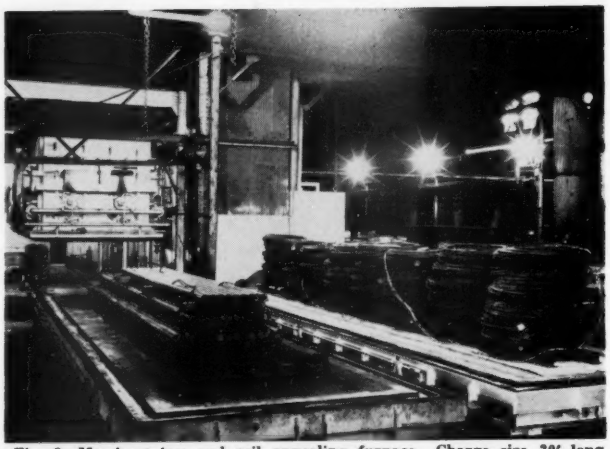


Fig. 2—Merchant bar and coil annealing furnace. Charge size 30' long x 48" wide x 42" high. Furnace lifted and cars withdrawn. One charge of bars and one of coils.

in Figures #1 and #2. It will be noted in Figure #2 that it is important to have the bar stock fairly evenly spaced in the charge for adequate distribution of the atmosphere gas. The bar stock must be pickled before annealing. For coiled rod stock the material must be pickled and limed prior to installation in the furnace and stacked as shown in Figures #1 and #2. Coiled rod can also be handled in a circular type furnace, using an alloy inner cover with liquid seals. This furnace has a very large movement of convection gases throughout the charge. For coil stock annealing, we feel this system has very definite advantages over the car type furnace. This system is shown in Figures #3 and #4.

Fig. 3—Charge of 3 stems of rod coils on 108" base. Total weight approximately 18,000 lbs. Base equipped with 25 H.P. fan motor.

Diagram #2 has been made up to show the schematic layout of the restoration system and a graphic layout of the complete carbon restoration cycle. We have also indicated in this diagram a carbon potential gauge. This gauge is installed on the natural gas flowmeter at the mixing station. You will note on this gauge that for the required carbon content in the steel, there is a comparable metered flow of natural gas. This

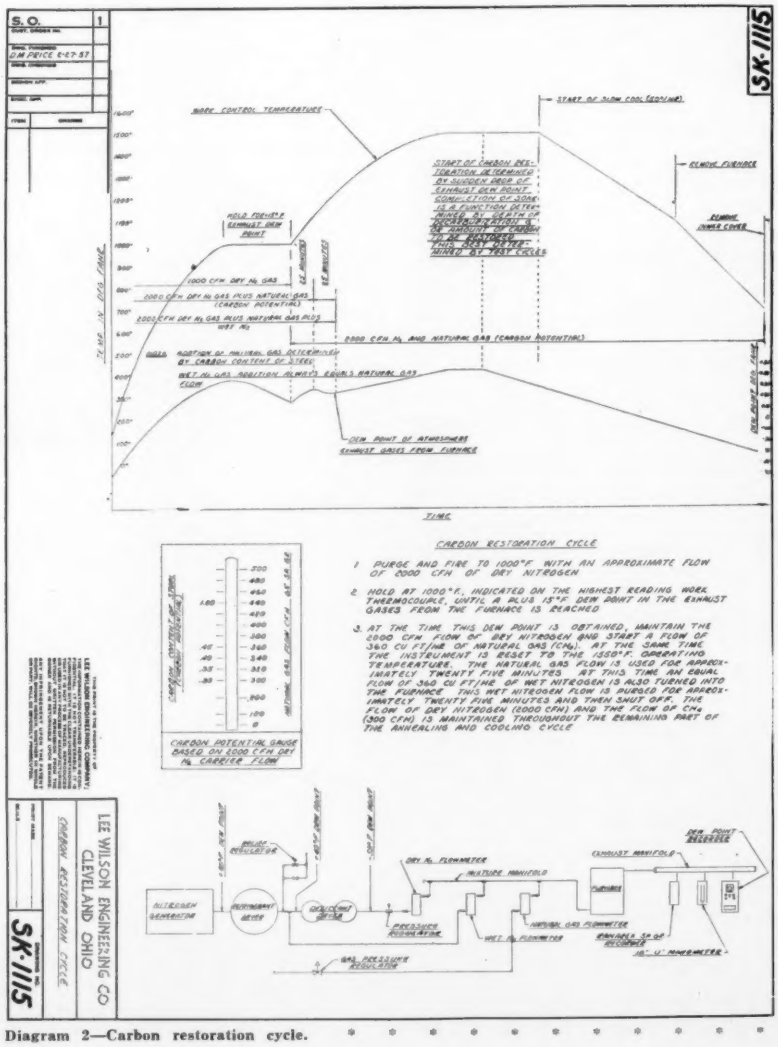

SK-1115
CARBON RESTORATION CYCLE
1. PURGE AND FIRE TO 1000°F. WITH AN APPROXIMATE FLOW OF 2000 CFH OF DRY NITROGEN
2. HOLD AT 1000°F., INDICATED ON THE HIGHEST READING WORK THERMOCOUPLE, UNTIL A PLUS 15°F. DEW POINT IN THE EXHAUST GASES FROM THE FURNACE IS REACHED
3. AT THE TIME THIS DEW POINT IS OBTAINED, MAINTAIN THE 2000 CFH FLOW OF DRY NITROGEN AND START A FLOW OF 360 CU FT/HR OF NATURAL GAS (CH4). AT THE SAME TIME THE INSTRUMENT IS RESET TO THE 1550°F. OPERATING TEMPERATURE. THE NATURAL GAS FLOW IS USED FOR APPROXIMATELY TWENTY FIVE MINUTES. AT THIS TIME AN EQUAL FLOW OF 360 CU FT/HR OF WET NITROGEN IS ALSO TURNED INTO THE FURNACE THIS WET NITROGEN FLOW IS PURGED FOR APPROXIMATELY TWENTY FIVE MINUTES AND THEN SHUT OFF. THE FLOW OF DRY NITROGEN (2000 CFH) AND THE FLOW OF CH4 (300 CFH) IS MAINTAINED THROUGHOUT THE REMAINING PART OF THE ANNEALING AND COOLING CYCLE
CARBON POTENTIAL GAUGE BASED ON 2000 CFH DRY N2 CARRIER FLOW
LEE WILSON ENGINEERING CO CLEVELAND OHIO
SK-1115
TIME

Diagram 2—Carbon restoration cycle.

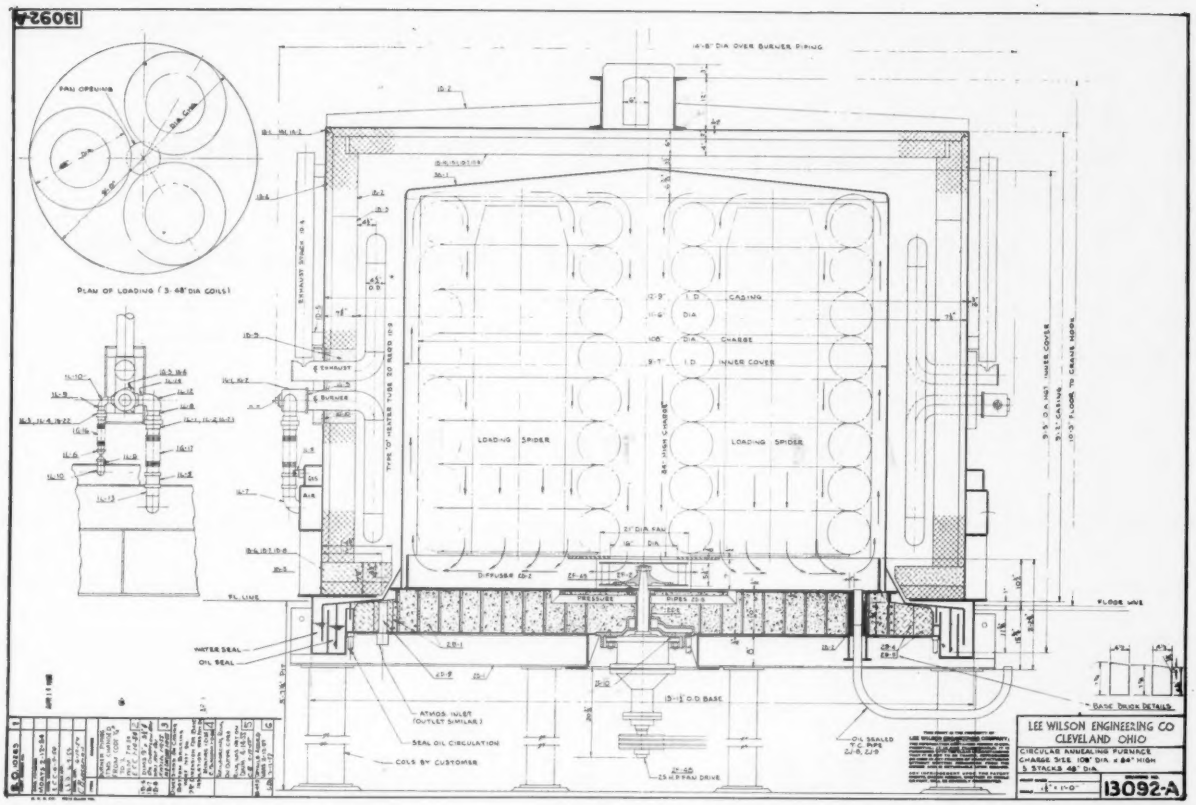


Figure 4. Cutaway of circular convection furnace.

natural gas is, of course, the carbon potential when mixed with the nitrogen carrier gases. The sequence of operation of this system is as follows:

A. With the furnace charged and adequately sealed, the furnace is purged with the correct flow of nitrogen (N_2) gas. This gas is maintained at a dew point of -50°F. or lower.

B. At the completion of the purge, the furnace is heated to a steel temperature of 1000°F. The furnace is held at this temperature until an exhaust gas dew point of +15°F. is obtained.

C. When the correct dew point is obtained in the exhaust gases the furnace is set at a temperature of 1550°F. At this time an adequate flow of natural gas is added to the initial nitrogen gas to maintain a carbon potential for restoring carbon in the steel to be annealed.

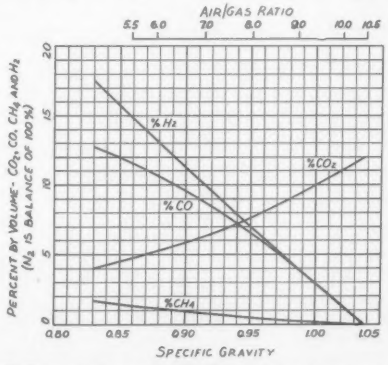
D. When a complete mixture of the nitrogen gas and the natural gas is obtained a flow of wet nitrogen gas with a dew point of +45°F. is also mixed with the first two gases. This gas addition will start a gas reaction within the furnace, indicated by an increase of CO and H_2 in the exhaust gases (by orsat). It will also be indicated by a dropping off of the exhaust gas dew point. At this time the addition of wet nitrogen gas can be stopped. The flow of dry nitrogen and natural gas is maintained throughout the remainder of the annealing cycle.

E. The holding time at temperature should be for a sufficient time to obtain complete penetration of carbon into the steel. The start of carbon restoration is determined by a sudden drop of exhaust dew point. Completion of soak is a function determined by depth of decarburization and/or amount of carbon to be restored. This is best determined by test cycles.

F. The cooling cycle should be controlled to obtain the desired metallurgical structure in the steel being annealed.

★ ★ ★

The nitrogen gas analysis is shown on Diagram #3 with the air-to-gas ratio set at approximately 9.1 part air to 1 part gas.


AIR/GAS RATIO
5.5 6.0 7.0 8.0 9.0 10.0 10.5
PERCENT BY VOLUME - CO2, CO, CH4 AND H2 (N2 IS BALANCE OF 100%)
%H2
%CO2
%CO
%CH4
0 5 10 15 20
0.80 0.85 0.90 0.95 1.00 1.05
SPECIFIC GRAVITY

Dia.3-Specific Gravity and Composition of Typical Exothermic Atmospheres from Natural Gas

This gives the following gas analysis of the stripped gas: 0.01% CO_2, 0.0% O_2, 3.5% CO, 3.5% H_2 and a trace of CH_4. The remaining gas is nitrogen. The dew point of this entering gas is —50°F., which is .01% H_2O by volume. The wet nitrogen gas has the same analysis with the exception of a dew point of +45°F., which is 0.8% H_2O by volume. The third gas used, of course, is natural gas which is primarily CH_4.

★ ★ ★

The action of the atmosphere gas components on steel is as follows:

O_2

Reacts with iron in steel to produce iron oxide (scaling).

$$2\ Fe + O_2 = 2\ Fe\ O$$

★ ★ ★

Reacts with carbon in steel to lower its concentration (decarburizing).

$$2\ Fe_3\ C + O_2 = 6\ Fe + 2\ CO$$

★ ★ ★

(*Please turn to page* 1250)

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A Method of Controlling the Contour of Tungsten Carbide Dies Used in Drawing Copper Wire

by

W. R. Moyers
Chief,
Wire Engineering Dept.

and

G. M. McLeod
Product Engineer,
Wire Drawing and Enameling Dies

Western Electric Company
Tonawanda, New York

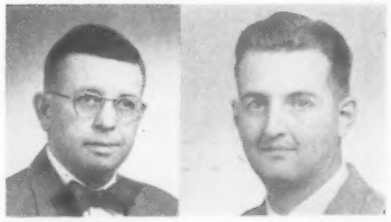
Electrolytically refined copper that is hot rolled into rod coils weighing about 250 pounds is the generally accepted raw material for the production of copper wire. For many years, this rod was "broken down" or reduced in diameter by being "cold drawn" or pulled through a series of cone shaped holes of successively smaller diameter in steel or chilled iron plates or slugs. These drawing dies were replaced because of wear after each coil.

★ ★ ★

In about 1928, sintered tungsten carbide was introduced as a substitute for the short lived steel or chilled iron. This new material with its hardness and high wearing qualities completely took over in a few short years. The door was now opened to producing long lengths of wire since this longer die life permitted continuous drawing by joining the coil ends by welding. The drop in drawing friction gained from using this close grained highly polished material permitted higher drawing speeds and a greater number of tandem reductions in a single wire drawing machine. This tandem arrangement, however, constituted a chain that was no stronger than its weakest link. The premature failure of any one die necessitated re-stringing the entire set. This was time consuming and expensive.

★ ★ ★

Experience in using this new die material soon determined the need for establishing and controlling the shape of the drawing surface within the die. This need led to the method for control and consistency as will be outlined here.



W. R. Moyers G. M. McLeod

A paper prepared for presentation at the Annual Convention of The Wire Association in Chicago on October 15, 1957. **Mr. Moyers holds a degree of B.S. in M.E. from the University of Texas. He entered the employ of the company in 1929 and spent 18 years at the Hawthorne plant as Engineer of Copper Rod and Wire Manufacture. Mr. McLeod has a degree of B.S. in M.E. from Northeastern University. He joined W.E. in 1955, having formerly worked for Design News Magazine.**

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As a result of experimentation involving the reduction into wire of millions of pounds of copper, the former conical hole became the contour shown in Figure 1. From the entering, or top side, of the die nib, the approach angle provides an opening for the lubricant to enter the working surface. The carefully drilled and polished entrance area is the major working surface in reducing the wire diameter. The land or bearing area sizes the wire, and the back relief provides the smooth exit necessary to avoid scratches or waviness. After establishing the contour of these working areas, any sharp corners caused by the intersection of the angles are blended during the polishing process. This results in a mirror finish that reduces frictional drag and heating.

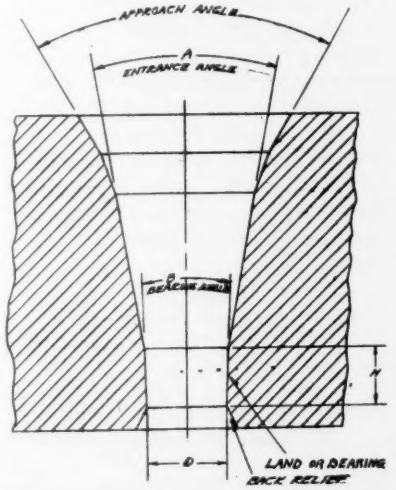

Fig. 1

Through this experimentation, it also became evident that a carefully controlled contour consistent with each die was necessary to realize the hundred-fold life advantage available by using tungsten carbide. Consistency in the length of the bearing proved to be an important factor in the success of these dies.

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It was also evident that the quantity of dies required by a large wire mill necessitated a production setup with tools and meth-

ods acceptable to semi-skilled workers. With this in mind, the procedure that became known as the "Dial Gage Method" came into use.

Theory

The Dial Gage Method measures the die bearing length. This is done by seating the die on a cone and plunger assembly and inserting a plug gage into the top or front of the die. The bottom surface of the plug gage meets and depresses the plunger until stopped by the squared tip of the plug gage contacting the entrance cone surface. The dial indicator measures and indicates the plunger displacement. During this operation the axial relationship of the component parts is maintained by a guide sleeve that holds the die case in a vertical position and a bracket above the die that locates the plug gage axis in the vertical plane.

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The relationship between the plunger displacement as indicated on the dial and the bearing length is a function of the entrance angle, bearing angle, back relief angle, diameter of die opening and plug gage diameter. This relationship can be expressed mathematically by:

$$R = E + \frac{D + 2H \tan \frac{B}{2} - G}{2 \tan \frac{A}{2}} + D\text{-}H$$

where: R = Dial Gage Reading
E = 0.020 inch (constant)
D = Diameter of Finished Die Opening
H = Bearing Length
B = Bearing Angle
A = Entrance Angle
G = Diameter of Plug Gage

The back relief or exit cone angle is cancelled from the above equation by manufacturing all dies with an exit angle of 53°8′. This angle is used because of the unique trigonometric characteristic it imparts to the cone, namely that the altitude of the cone and the corresponding base diameter are always equal.

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This equation is simplified by specifying that the bearing angle for copper drawing dies is 4°. Inasmuch as the entrance cone becomes sharper as the die opening or size decreases, a further simplified equation was set up for each entrance angle.

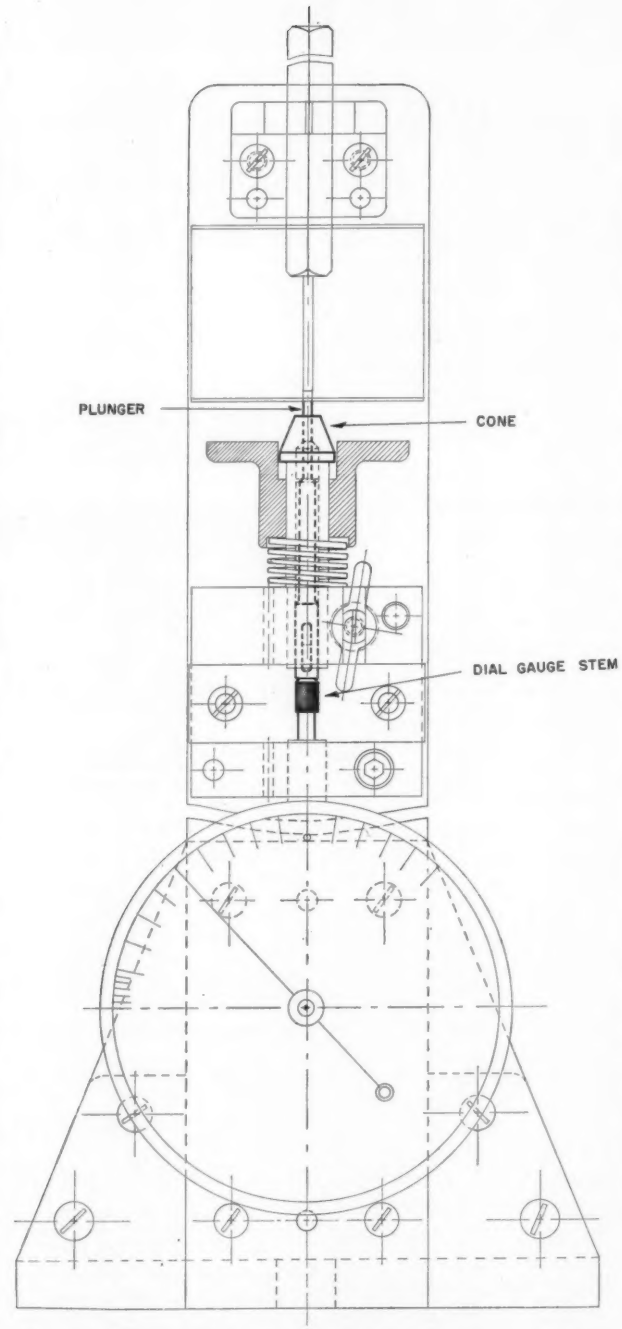

Fig. 2—A plunger moving within the locating cone actuates a dial indicator to measure the bearing length. Upper limit of bearing is determined by tip diameter of plug gage.

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It is unnecessary for the operator to make any calculations since the functional engineer supplies tables showing the correct dial reading and plug gage size. These tables for each operator are calculated using the simplified formula; for example, a die having a 14° entrance angle:

$$\text{Dial Reading} = E + 5.072D - 4.072G - 0.716H.$$

This will give the correct bearing length for each die.

(*Please turn to page* 1253)

Appropriate Rods for Appropriate Wire

by Ivan P. De Witte, C.E.
Manager Research and Control
Trefileries Leon Bekaert
Zwevegem, Belgium

The author is a graduate of the University of Louvain, from which he received a degree of Civil Engineer. He joined the company in 1938 and has been active in several positions since then.
The paper was prepared for delivery at the Annual Convention of The Wire Association in Chicago on October 16, 1957. It treats of the problems encountered in their own mills of producing steel wire rods.

The Importance of Appropriate Rod Quality

The quality of raw material has always been essential in any industry, but it can confidently be said that in steel wire production the quality of rods is a vital matter. Small wonder then if, right from the very beginnings of the Wire Association, this matter has been the subject of such close attention. Throughout the years of the Association's existence, many papers and extensive discussions have, at least partly and often in their entirety, been devoted to rod quality.

* * *

It is self-evident that all Members of the Wire Association have a particular interest in appropriate rod quality. Therefore it is believed that a brief statement on what "appropriate rods for appropriate wire" actually means in the Bekaert company's rather specific case, might be of interest. In fact such a statement may, we feel, raise a number of points which sooner or later could well prove useful to some Members.

* * *

The Bekaert case is indeed rather a special one. It is one of Europe's biggest steel wire mills, producing both mild steel wire (some 75% of its total output) and high carbon steel wire (the remaining 25%). Hardly believable as this may sound, yet this mill is unable to find, in its own inland market, an outlet for a full 30% of its total production. And of course, for the remainder, i.e. 70% of the total output, customers have to be found abroad, actually in not less than a hundred different countries. This position is probably unique.

In addition, many as are those who buy wire from us, still more manifold are their particular, widely different and often variable requirements. To suit each one of these as well as ever possible obviously calls for the use of absolutely every means of producing the broadest possible variety of appropriate finished wire. This is not merely a matter of equipment and experience, but—to a large extent—of the availability of appropriate rods.

Consequences as to the Sources of Rod Supply

Such being the case, is it better for Bekaert's to buy the rods or to produce them?

* * *

Having started as a quite modest mill for which producing its own rods was quite out of the question, Bekaert's have in later years repeatedly considered the advantages and disadvantages of going over to producing at least part of the rods required. The upshot was that to-day we still buy all our rods, not producing a single coil of them. Rods are usually supplied by about a full dozen firms in approximately half a dozen countries, including Belgium, the neighbouring countries and Sweden. Only occasionally do some rods come from other sources.

* * *

It is, of course, fully appreciated that, if a company has its own facilities for rod production, it is relatively easy to make this or that alteration for trial purposes, or to bring in some lasting improvement. To have outside suppliers alter their equipment or techniques for test purposes or in order to supply us with products better suited to our requirements, is by no means as easy. On the other hand, what with the requirements of our customers being so various and unceasingly changeable, it is obvious that any single steel plant or single rod mill would lack the versatility needed to adapt themselves. In this specific situation, if all our requirements have to be met, we have to avail ourselves not only of the limited possibilities of a single rod mill or merely of a few ones, but of all the various and periodically developing potentialities of the many rod mills that are willing to supply, and, as a matter of fact, are at times even anxious to be able to do so.

Non-Specific Aspects of the Rod Problem

As far as "appropriate rod quality" is concerned, a number of aspects of the problem are common to all mills. Such common aspects will only very briefly be dealt with here, as they have often and extensively been commented upon, in books and brochures, and in articles and papers, the majority of which have been published in "Wire and Wire Products".

* * *

In order to ensure sound and uniform performance of the finished wire, or of the product manufactured out of it, the rods have to be submitted to a large number of checks and controls.

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These may be different in each case according to the purpose of the product. It may be useful to enumerate a number of such control operations and incidentally to mention a few related details:

1. Control of steel composition, especially with a view to checking whether the carbon content is within the specified limits. Due to the fact that the ultimate tensile strength of the finished wire quite often has, on customers' request, to be comprised within a very narrow range, Bekaert's have had in all carbon ranges, to lay down limitations of no more than five points for carbon content (2).
2. Sulphur and phosphorus should of course be kept to a minimum in accordance with the final use (2) (3).
3. The so-called "tramp" alloys have to be kept as low as possible, and certainly below specific upper-limits of, for instance, .10% Cr, .15% Cu, and so on (2) (4) (5).
4. The depth affected by decarburization should constantly be kept within reasonable limits, and in some particular cases within very restricted limits, e.g. for wire or wire products which have eventually to be oil hardened, wire with high fatigue resistance properties, and so on (6) (7).
5. Pipe and segregation being highly detrimental, rods have to be inspected against these defects. In each case an additional and careful survey is required in order to be able to decide which type of steel is best suited: whether rimmed or capped steel is acceptable, or—on the contrary—semikilled or even fully killed steel has to be specified (4) (8) (9).
6. Rod samples have to be tested for non-metallic inclusions, restrictions on the amount, magnitude and nature of which depend on the final size of the finished wire, such fatigue resistance and other mechanical properties as are required, final use, etc. (6).
7. There are several well-known cases, and at least as many disputed ones, where attention should be paid to grain size (5) (10) (12).
8. Surface condition should of course always be smooth enough to permit easy drawing, but in quite a few cases specific limitations to surface imperfections have to be stipulated, and the rods have to be inspected under this aspect (2) (6).
9. Shaped wire may require particular specifications as to rod section, but, whatever the section, size tolerances must be respected in all cases, and particularly in the case of rods which are not markedly easy to draw (12).
10. Finally, the importance of reduced scale loss and of corresponding care in rolling the rod are worth mentioning (13).

Specific Aspects of the Rod Problem

Leaving it at this concerning non-specific aspects, it is intended now to deal more extensively with specific aspects of Bekaert's rod problem, and first of all with the matter of mild steel.

A. Mild Steel Rods

In Belgium—as also in France and Luxembourg and, to some extent, in Germany—most of the mild steel is produced by the basic pneumatic process. This process consists essentially in blowing a gas, containing oxygen, into liquid pig iron. This blast refining formula, unlike hearth refining, does not require the use of any outside fuel. The required heat is liberated by the exothermic reactions between the oxygen of the blast and the elements present in the pig iron. Such elements then have to be present in the pig iron in sufficient amounts. This is the case when using, as is done in Belgium and the neighbouring countries, ores with a high phosphorus content, as those from Lorraine and Sweden. These ores yield a pig iron of exactly the required analysis, as, in the blast furnace, the phosphorus in the ore is largely reduced and is incorporated in the iron.

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This basic pneumatic process is called "thomas" in Europe and "basic bessemer" in this country.

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To-day, not just one, but several grades of basic bessemer steel are available. In addition to normal basic bessemer on the one hand, consideration will be given to special basic bessemer steels in general on the other.

a. Normal Basic Bessemer Steel

Normal basic bessemer steel, as you know, contains less carbon, but more phosphorus, sulphur and nitrogen than open hearth steel (14). (See Table 1.)

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Whereas the preparation of an open hearth cast takes several hours, only about a quarter of an hour is required to finish a basic bessemer cast; the equipment in the latter case is less bulky and simpler; as already mentioned no outside fuel is required; the slag being a valuable fertilizer, its sale is an important factor in the overall economy of the process (15). As a result, in the European Coal and Steel Community, basic bessemer rods are, under equal conditions, at least 10% cheaper compared with open hearth rods for which the steel was processed from a partly molten charge, and up to 15% and 20% cheaper than rods for which the open hearth steel was processed purely from scrap.

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As the American Iron and Steel Institute Products Manual puts it: "Each grade and quality variation thereof," i.e. of steel, "has a proper and useful place, depending upon the end use and the methods of fabrication" (9). This applies also to normal basic bessemer steel.

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The only drawbacks of wire made out of this steel are lack of torsions in the as-drawn condition, and some unevenness of mechanical properties in the annealed condition. These are of small, or even of no, importance for many uses, while for other ones the difficulties can be counterbalanced or overcome.

★ ★ ★

Barbed wire, fencing wire and fences, broom wire, baling wire, bag tie wire, clothes pin wire,

	C %	Ph %	S %	N %
Normal basic bessemer	.04—.10	.033—.057	.028—.042	.0090—.0120
Open hearth	.08—.13	.010—.030	.025—.040	.0030—.0060

Table 1. Steel compositions for normal basic bessemer and open hearth processes.

armor wire, netting wire, insect screen wire, tag wire are a few cases in which normal basic bessemer rods can be used instead of open hearth rods without any special precautions, while in the case of chain link fence and coat hanger wire some special care is required.

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In telling the story of Wickwire Brothers, however, **K. B. Lewis** mentions the following: "A generation ago Wickwire Brothers was known in the trade largely as the people who had solved the mean problem of making weaving wire from basic steel. Bessemer had always been the stock for fine wire and as bessemer practice slowly died out and the rods got scarcer, many producers made heroic efforts to switch to basic steel, which as a matter of fact many of them produced at their own plants. It was discouraging. The strands tended to stick together in the pot when annealed in small sizes, and the stuff was too soft. Lacking a certain crispness characteristic of bessemer, it raised hob on the loom" (1). This then is a case in which open hearth steel had to overcome the disadvantage of lacking a property characteristic of both acid and basic bessemer steel wire, a certain stiffness which in some cases is a definite advantage. In the case of common nails, conditions are similar, as also in the case of rock fastener wire and florist wire.

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Although there is no demand for it in the U.S.A., in Europe there still is a fairly big demand for a grade of spring wire generally accepted for furniture and which is drawn from normal basic bessemer mild steel rods water quenched from 1300° F. The finer grain size of these rods, as against that of open hearth steel rods, accounts for the fact that only with the former are satisfactory properties to be achieved. The nitrogen content in this case is also an advantage, as it enhances age-hardening effects.

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By far the most important advantage of normal basic bessemer derives from its composition, a fact that is experienced in galvanizing operations, especially in wiped galvanizing. Speaking of the improved galvanizing process developed by Crapo, K. B. Lewis says essentially the following: ". . . comparatively pure iron . . . is very resistant to solution in molten zinc and so to bonding satisfactorily with it. A high carbon steel or a steel whose silicon or phosphorus has been raised for the purpose yields quickly and takes a good tight coat . . ." (1). There is another theory relating the better bonding with grain size. As the composition of basic bessemer is the origin of both the better solubility and finer grain, it is hard to tell which is the correct scientific explanation. The fact remains that without any precaution and quite automatically, an intimate bonding of the zinc layer to the underlying base metal is obtained in galvanizing normal basic bessemer wire.

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Uses for which normal basic bessemer has to be rejected are only those for which extremely uniform properties are required: reed wire, bobby pin wire, paper clip wire, pin wire, brush handle wire, can key wire, bookbinding wire, stitching wire, and so on. Also telephone and telegraph wire on account of the high conductivity required. Some years ago, only open hearth steel could be considered in all these cases. To-day however special basic bessemer grades have been developed, which can without the least disadvantage replace open hearth steel in almost any case. It is proposed now to summarize the main characteristics of such grades.

b. Special Basic Bessemer Steel Grades (14) (15) (16)

As already recalled, the principle of steel production developed by Bessemer consists in blowing a gaseous fluid containing oxygen into liquid pig iron. In the conventional or acid bessemer process the converter is acid lined, while the thomas or basic bessemer process uses a vessel with basic lining, the gaseous fluid in both cases consisting of atmospheric air, blown from the bottom.

Recent improvements to these processes consist in enriching the blast in oxygen or even cutting off the blast and replacing it with mixtures of oxygen and a nitrogen-free gas: steam or carbon dioxide. An increase in bath temperature results and has to be neutralized by further additions of scrap, ore or limestone. Latest developments consist in top blowing instead of bottom blowing or in oxygen lancing in addition to bottom blowing.

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As may be seen, the possibilities of using all these techniques separately or in conjunction with each other are many. Most of them are already currently applied in industrial production. Many are, as a consequence, the grades of special basic bessemer steel offered; to give an example, a single Belgian steel plant offers nine different grades, which differ by decreasing upper-limits for nitrogen, phosphorus and sulphur.

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By the way, the use of these processes is not restricted to Europe; nor is oxygen lancing possible only in a converter: it can also be applied in the open hearth process and this is being done in this country (17). Both in Canada and the U.S.A., the LD-process or Linz-Donawitz process of oxygen lancing has been applied, not only for test purposes, but also to small scale industrial production, and this so successfully that at least one larger-scale plant is already being erected (16).

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Even though the actual costs involved are not known accurately by the authors, it is evident that they must vary according to the grade considered. It is felt, however, that in the industrial production of even the purer grades, such costs cannot exceed, or even reach, the cost of open hearth steel.

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The main advantages of these processes, considered in general, are the following:

1. **lower nitrogen-, phosphorus- and sulphur contents than in normal basic bessemer steel, and in some**

cases even lower such contents than in open hearth steel:

2. carbon content lower than in open hearth steel;
3. contents of residual elements as Cu, Ni, Sn, Pb, etc. . . can be made lower than in open hearth steel;
4. the steel-making process can be speeded up, by as much as 20% in some cases;
5. more scrap can be consumed, and pig iron, that would be off-grade in the case of normal basic bessemer, can be used in the special processes for which the limitations as to pig iron composition are not so narrow;
6. this steel lends itself very well, and at no high cost, to duplexing in an electric furnace for production of alloy steel;
7. on account of the recurrent scrap shortage in the European Coal and Steel Community, and to a lesser extent also in other parts of the world, this steel is most valuable in replacing in many cases open hearth steel, which requires more scrap, by some special grade of bessemer steel, which requires less such scrap;
8. finally, and this interests chiefly wire men, these special basic bessemer steels have much broader applications than the normal grade. According to some investigators, provided steel has a low enough content in nitrogen and phosphorus, whether it is an open hearth steel or a bessemer steel has no importance, even for most exacting uses such as extra-deep stamping (18). This largely applies to the case of wire, as will now be seen.—

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One investigation was made, using eight coils of 5 mm.-rods, i.e. approx. n° USSWG 5, of each of five different grades: basic open hearth steel, normal basic bessemer and three grades, of increasing purity, of special basic bessemer. For all five grades the carbon, manganese and silicon were almost the same, the carbon content — incidentally — being about .05. Only nitrogen, phosphorus and sulphur, as a result, could have some bearing on the behaviour in drawing and on the properties of the finished wire. (See Table 2.)

	C%	Mn%	Ph%	Si%	S%	N%
Normal basic bessemer	.050	.377	.0385	....	.024	.0100
Open hearth (basic)	.049	.267	.0125	....	.038	.0040
Special basic bessemer I	.052	.352	.025	.010	.020	.0080
Special basic bessemer II	.056	.389	.018	.010	.019	.0059
Special basic bessemer III	.051	.360	.018	.010	.024	.0022

Table 2. Steel compositions of the different grades used for the investigation.—

All these rods, eight coils of each grade as already mentioned, were drawn, without annealing, and with almost equal facility, as far as .35mm. or 14 mills. As a matter of fact, the rods were drawn as far as possible, a few small coils as far as .22 mm. or approx. .009", but not without trouble.

★ ★ ★

Results of tests on the finished wires were as follows:

1. The ultimate tensile strength of the wires drawn to the .35 mm. or 14 mills and the immediately preceding stages was lower for the purer grades II and III of special basic bessemer than for open hearth steel. —
2. Striction figures were almost the same for all five grades.—
3. Elongation in 100 mm. or 4 inches, quite unexpectedly, was minimum for open hearth steel and increased in relation to the nitrogen content for the three special and one normal basic bessemer grades.—
4. Measured on a Tinius Olsen Stiffness Tester, the return angle was smaller for the purer grades II and III of special basic bessemer steel than for open hearth steel.
5. In the bending test, however, open hearth steel was at the top, the basic bessemer grades showing decreasing bending figures as the nitrogen content was getting higher.
6. In the torsion test, as a rule and with only few exceptions the lowest torsions per 100 diameters were found after drawing the wire five holes, i.e. to 2.13 mm. or USSWG n° 14 approx., and the highest after 10 holes, i.e. at a size of 1.07 mm. or approx. USSWG n° 19. After ten holes, the open hearth steel and all three grades of special basic bessemer have an almost equal number of torsions, the normal basic bessemer of course being poorer. After the fifth hole, on the contrary, the open hearth steel has the most torsions and the bessemer grades have increasingly less as the nitrogen content increases. But then again, after one hole only, the purest grade of basic bessemer has slightly more torsions than the open hearth steel.

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Instead of comparing the average figures of 8 coils of each grade at only one size, an average was computed in each case of the five sizes nearest to ten hole; this has the advantage of giving a more statistically balanced figure, based on forty different measurements. The sizes considered were those of the wire drawn 8, 9, 10, 11 and 12 holes, respectively to 1.44, 1.20, 1.07, .95 and .80 mm. or approx. USSWG n° 17, 18, 19, 20 and 21. In doing so, the following figures were arrived at:

—open hearth steel ..... : 37
—special basic bessemer III .. : 36.8
—special basic bessemer II .... : 35.6
—special basic bessemer I ..... : 35.6
—normal basic bessemer ..... : 28.4

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In much the same way, average figures have been compared for the five sizes nearest to five hole, i.e. 3, 4, 5, 6 and 7 holes, or respectively 2.97, 2.51, 2.13, 1.87 and 1.59 mm., approximately USSWG n° 11, 12.½, 14, 15 and 16. The figures then were:

—open hearth steel ..... : 33.2
—special basic bessemer III .. : 33.3
—special basic bessemer II .... : 13.3
—special basic bessemer I ..... : 8.4
—normal basic bessemer ..... : 5.2

★ ★ ★

Obviously, it is in the latter size range that in many cases the purest special grade of basic bessemer has to be used, or particular care has to be taken. It is also to be noted that, in this size range, hot spelter galvanizing, and the heat treatment involved, results in a greater improvement of the mechanical properties of open hearth steel than of basic bessemer steel.

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In addition to these comparisons, a few more practical tests were also made with wire from several casts of special basic bessemer, having nitrogen contents between .0050 and .0070%, sulphur between .017 and .036%, phosphorus between .021 and .051%, manganese between .363 and .390% and normal low carbon (not analyzed, probably between .04 and .07%).

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Amongst others, very broad-headed slating nails were made out of this wire quite as successfully and easily as out of the usual

(*Please turn to page* 1268)

Continuous Electric Direct Resistance Method for Heat Treating of Steel Wire

by Oscar C. Trautman, President
The Trauwood Engineering Company
Cleveland, Ohio

This paper was prepared for presentation at the Annual Convention of The Wire Association in Chicago on October 15, 1957.

Many efforts have been made to find a practical method whereby material could be heated by means of its resistance to the passage of an electric current.

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It had been recognized throughout industry that heating by such a method would offer many advantages, whether it was desired to fabricate or to condition it by further steps of metallurgical practise.

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Several of these steps were for the purpose of patenting, annealing, and oil tempering of steel wire. Early attempts to heat wire continuously by passing an electric heating current through it were met with failure.

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Chief of the disadvantages developed in methods of heating by electric resistance has been in arcing, which caused pitting of the surface of the wire. Another disadvantage has been a variation in density of current flow due to poor contact which produced non-uniform temperature in the wire.

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The pitting caused by arcing was particularly serious when material under heat treatment was steel wire and was to be used in the manufacture of rope wire or in the making of springs.

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The variations of the temperature of the wire also caused variations in the qualities of the wire which were highly objectionable. The disadvantages of heating wire by electrical resistance under all previous proposed methods were never accepted by those engaged in the heat treatment of steel wire.

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Of recent years a practical method has been developed for the heat treatment of steel wire which overcomes all of the early difficulties and disadvantages. The new development provided a method of heating wire, rod, or strip progressively throughout its length to a desired constant maximum temperature, without arcing or injuring the surface of the material by decarburization or by pitting. It also provided a method whereby the material could be so heated to a constant maximum temperature and immediately quenched if desired.

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In conventional methods of heating wire for patenting, annealing or oil tempering; gas fired furnaces, baths of molten materials at high temperatures or muffle furnaces are used. In any of these the material under heat treatment is heated from the outward surfaces inwardly. The rate of heating when using such conventional methods is considerably slower than desired for best practises for some purposes. Also, in gas fired furnaces and similar means of heating by burning fuel, there is a definite tendency to injure the surface of the material. Many other objectional features attended these methods, the surface of the wire may become decarburized, the heating is accomplished at a slower rate than is desireable; and it is necessary to heat the wire to a substantially higher temperature than that which is desired to quench from.

In heating by the **Electric Direct Resistance Method,** apparatus is provided whereby, in continuous operation, steel wire is heated by its electrical resistance to a desired controlled temperature from which it may be further heat treated or allowed to cool to atmospheric temperature.

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The electric direct resistance method of heating wire or strip provides a method whereby, in continuous operation, steel wire and the like is heated, by its electrical resistance, to a temperature at which its iron content assumes the gamma form, and is then rapidly partially quenched from its maximum temperature to a desired controlled temperature, from which it may be further treated or allowed to cool to atmospheric temperature.

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By this method the material can be partially quenched to a controlled temperature and then immediately, in continuous operation, further quenched to atmospheric temperature under controlled conditions which impart to the steel the qualities desired.

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In addition, to avoiding the disadvantages of furnace heating, the electric direct resistance method has other distinct advantages which have been recognized by the wire industry, for instance, it is possible to either patent, anneal, or oil temper wire or strip, all on the same unit. The equipment for the practice thereof is reasonable in prime cost and maintenance charges. Such equipment is then ideally adapted for combination with that which is required to

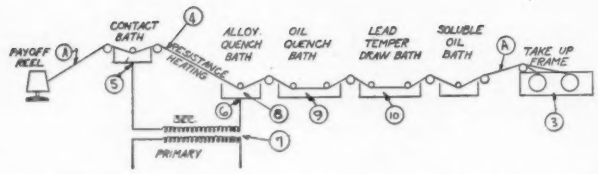
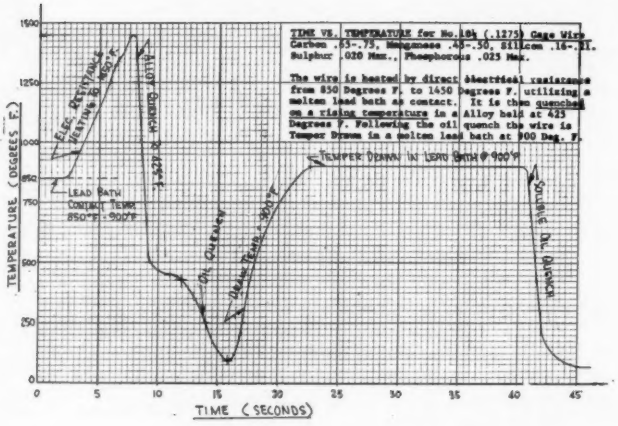


Figure 1—above

Figure 2—at right


TIME VS. TEMPERATURE for No.10½ (.1275) Cage Wire
Carbon .55-.75, Manganese .45-.50, Silicon .16-.21,
Sulphur .020 Max., Phosphorous .025 Max.
The wire is heated by direct electrical resistance
from 850 Degrees F. to 1450 Degrees F. utilizing a
molten lead bath as contact. It is then quenched
on a rising temperature in a Alloy bath at 425
Degrees F. Following the oil quench the wire is
Temper Drawn in a molten lead bath at 900 Deg. F.
TEMPERATURE (DEGREES F.)
TIME (SECONDS)
ELEC. RESISTANCE HEATING TO 1450°F.
ALLOY QUENCH @ 425°F.
LEAD BATH CONTACT TEMP. 850°F. - 900°F.
OIL QUENCH
TEMPER DRAW @ 900°F
SOLUBLE OIL QUENCH

subject the heat-treated wire to further processing in preparation for any particular use. The heating of the wire is so rapid, being at a uniform rate throughout its cross-section, and the wire is at a high temperature for so short a time that no appreciable scale is formed.

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Figure 1 is a diagram of apparatus for carrying out a heat-treatment method which is commonly called oil tempering.

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Figure 2 is a time-temperature curve showing the results for a sample of wire when heat treated by the electric direct resistance method.

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We will first consider Figures 1 and 2 and the conditions and circumstances affecting the heat treatment of steel as illustrated therein.

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In a steel which has been heated to a temperature above its upper critical range, the iron will be in the gamma form, and carbon up to 1.70% will be held in solid solution. This phase is called austenite.

★ ★ ★

If the steel cools slowly through its critical temperature, there will be a precipitation of ferrite, which is alpha iron very low in carbon from the solid solution, if the carbon content is below the eutectoid composition which is about .87% carbon, and cementite, FE3C. if it is above. The precipitation will continue as the temperature continues to drop until the carbon content of the remaining austenite reaches the eutectoid composition. When this point is reached, the austenite transforms, depositing ferrite and cementite simultaneously, because the iron changes to the alpha phase, and the solubility of carbon therein is low. The cementite precipitated will assume the form of very thin plates which will lie in thin layers alternately with the ferrite, provided the rate of cooling is such that there is the time interval necessary for this arrangement of the products of the transformation. This structure, so formed, is known as pearlite, and in it the percentage of cementite and ferrite will be such that on analysis the structure will be found to contain .87% carbon, or the same percentage as was held in solid solution at the moment of transformation from gamma to alpha iron.

★ ★ ★

Hardness and strength in carbon steels are attributes of the free cementite dispersed homogeneously in the ferrite. It is necessary, when these attributes are desired, that the steel be quenched rapidly from a temperature at which the iron is in the gamma form. Thus the carbon released as cementite will be homogeneously dispersed throughout the ferrite, forming martensite, and the above recited structural transformation into pearlite will be inhibited.

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With this method a wire or strip may be rapidly heated and instantly quenched as it attains a desired temperature. The wire or strip is advanced uniformly into a bath of molten metal, through which bath a heating current of electricity is supplied, and caused to flow through, a section of the wire or strip. By regulating the distance between the two baths, or by modifying the current strength, or by changing the speed at which the material is advanced, the material may be caused to enter the quench bath at a uniform desired temperature. The rate and degree of quenching resulting therefrom may be controlled by selective choice of a conductive medium in the quenching bath and by maintaining the bath at a desired temperature. By this method the percentages of pearlite or of martensite produced when the carbon transformation results from the quenching of a carbon steel wire may be very accurately controlled. By using an electrically conductive bath capable of absorbing heat at a rapid rate, and maintaining it at a comparatively low temperature, a very hard product is produced which is practically 100% martensite.

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By heating the wire by the method explained and maintaining the quenching contact bath at a temperature in the neighborhood of 1000°F. the formation of extremely fine lamellar pearlite results. If the wire is retained in the quenching contact bath for a number of seconds a form of steel will be secured such as heretofore has been secured by processes known as "patenting."

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By the controlled use of this method, a heat-treated wire is produced which has novel characteristics which make it better adapted for use in springs than wire heat treated by conventional

methods. The wire is heated to a temperature at which the steel became substantially austenitic, that is, a temperature of the order of 1450° or 1650°F., depending upon the analysis of the particular steel. The wire, as it attains its maximum heat, is quenched in an electrical contact bath of molten low melting alloy maintained at a temperature of about 425°F. and is then withdrawn for further quenching at a slower rate in oil.

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Referring to Fig. 1, which shows diagrammatically apparatus used in the practice of this method, the wire A is drawn through the apparatus by a takeup frame 3. A section 4 of the wire is subjected to a heating current of electricity supplied thereto by the electrodes 5 and 6 as it is advanced through the apparatus. Current is supplied to the electrodes 5 and 6 from a suitable source 7. The advance electrode 5 is a molten metal, maintained at a desired temperature. The strength of current, length of section 4 and speed of wire travel are so adjusted that each cross section of the wire will attain a predetermined temperature as it enters the bath 8 and is quenched. From the bath 8 the wire is further quenched to a temperature of about 125°F. which is preferably done in an oil bath 9.

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The drastic quench from the temperatures of austenitic formation causes some stresses within the steel which it has been found advisable to remove by prompt drawing or tempering. The wire is, therefore, reheated to about 800° to 900°F. as it emerges from the oil quench, preferably by passing through a lead pot 10 maintained at the desired temperature.

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In heat treating steel wire by the electric direct resistance method spring wire having the following characteristics is produced.

(a) a structure in which cementite is predominantly dispersed homogeneously throughout ferrite in other than lamellar pearlite arrangement, and substantially without needle formations of martensite,
(b) high tensile strength,
(c) high fatigue strength,
(d) ductility with unusual hardness, and
(e) a superior surface finish free from objectionable oxides and decarburization.

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A wire of No. 11 gauge, .120 inches in diameter, containing .60 to .70% carbon and about 0.90% manganese was heated to a temperature of 1450°F. as it entered a quenching electrical contact bath of molten metal maintained at a temperature of 425°F. From this molten metal quench, it was withdrawn and passed through an oil quench which reduced its temperature substantially to room temperature. The wire so treated has a very fine martensitic structure with an absence of needles of martensite, and a Rockwell hardness of 64 to 66C. with an impact strength eight to ten times that secured in the same steel when hardened by conventional methods. To temper for spring purposes, this wire was reheated to 850°F. and quenched in soluble oil thereby reducing the hardness to 45 to 47 Rockwell C., with a structure wherein the homogeneously dispersed cementite has tended to form fine globules.

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Steel wire which has been hardened by this method, and tempered, will show a marked improvement in elasticity over that which can be attained when similar wire is hardened by older conventional methods of heat treatment. This may be readily demonstrated by torsion tests and by determination of elastic limits. Tests, using the Johnson 50% method of determination, have shown that the electric direct resistance method of hardening steel wire will result in an increase in elastic limit, in tensile strength, of more than 10% over that obtained when conventional methods of hardening are used.

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It is the belief that these superior characteristics of wire treated by this method result because, in the heating stage, the wire is heated evenly throughout its cross-section and progressively throughout the length of the section being treated, whereby at any instant only a short length has attained the maximum temperature. Then this short length, as soon as it is heated to the desired maximum temperature, is instantly quenched, thereby inhibiting the formation of undesired grain growth which occurs in steel held at a high temperature for a longer period of time and because in the quenching stage the temperature is dropped substantially and instantly, from the maximum, to a temperature below that at which the carbon rejected from the solid solution, will form the structure known as lamellar pearlite. The time interval being too short for the formation of the lamellar pearlite arrangement, the rejected carbon will form free cementite (Fe_3C) in substantially homogeneous dispersion in alpha iron holding a trace of carbon in solution.

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The speed of the heating is such that no part of the wire is at an oxidizing temperature for a time sufficient to permit any substantial oxidizing of the steel to form scale, or any oxidizing of the carbon causing de-carburization. Such oxidation may be completely inhibited by inclosing the portion of the wire adjacent the quenching bath with an envelope of gas which is inert to the steel.

★ ★ ★

It is believed the speed of the quench is such that the transformation of carbon, that results upon conversion from gamma iron to alpha iron, is accomplished in a time interval too short to permit the cementite formed to assume the lamellar relation with the ferrite, which is known as pearlite. It will be understood that the formation of lamellar pearlite, takes place only at a limited range of temperature, below the temperature at which the iron changes from the gamma to the alpha form, and that such formation in such range of temperature requires an appreciable period of time. It is the belief that the formation of any appreciable amount of lamellar pearlite is inhibited by

the substantially instantaneous quenching of the austenite, or solid solution of carbon in gamma iron. Further, by limiting the rapid quench and arresting at a temperature just below that of pearlite formation, from which it is more slowly cooled, a homogeneous dispersion of cementite in ferrite, or martensite is secured. This martensite formation having been secured, the stresses are relieved and the martensite is modified to secure the proper ductility by an appropriate temper draw.

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It has been recognized that steel rapidly quenched from a temperature, at which it was austenitic, that is to say, at which it held carbon in solid solution in gamma iron, to room-temperatures, would produce a steel which was martensitic in structure. Also such structure may be produced with a great decrease of internal stresses by a step-by-step quenching, or by very rapidly quenching to a temperature just below that at which pearlite transformation will take place and then completing the quench at a slower rate. The essential steps, used in all applications of the electric direct resistance method of heat treating steel wire or strip may be modified to secure a particular desired final result, such as is required in oil tempering, patenting, or annealing.

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The annealing of stainless steel or other alloy steels can be readily accomplished, because the high temperatures required for such heat treatment are easily obtainable. It is only necessary to raise the voltage somewhat to obtain temperatures around 1800°F. to 2000°F. or higher. When the conditions have been established which are required to give a particular steel certain definite physical properties, the operation can be set for those conditions and continued indefinitely with little or no attention.

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As an example, let us consider heat treating steel wire of No. 10½ gauge (.1275 in.) having the following analysis: Carbon: - 0.65 - 0.70, Manganese: 0.45 - 0/50, Silicon: 0.16 - 0.21, Sulphur: 0.020 maximum, and Phosphorus: 0.025 maximum. This wire was heated to about 1475°F. which temperature was maintained by modifications of the strength of the heating current, made automatically by a voltage control unit responsive to line voltage changes. The alloy of the quench bath was maintained at substantially 425°F. and the travelling wires were kept therein about 4 seconds. From this alloy, they were drawn through quench oil. At the end of twenty seconds, the wires were drawn from the oil quench at a temperature of about 125°F. and were passed through a lead bath maintained at approximately 900°F. in which they were retained for about 18 seconds for tempering.

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In Figure 2 a time-temperature curve is shown illustrating the heat treatment given this wire.

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The wire so treated developed the following physical characteristics:

Tensile strength	**248,000 Psi**
Elastic limit (Johnson's)	**229,000 Psi**
Elongation in 10 inches	**3.1%**
Elongation in 2 inches	**5.2%**
Reduction in area	**54.8%**
Torsion (no. twists in 10 in.)	**25.0**
Hardness (RockwellC.)	**45.0**

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When the electric direct resistance method of heat treating is used in the process known as "patenting", which is the conventional treatment given steel wire to prepare it for reduction by drawing, the "patenting" is secured by heating the wires, as already explained, to a point above the critical temperature for the particular steel. The molten metal of the quench pot is maintained at about 950°F and the wires are held at this temperature sufficiently long to complete transformation before air cooling.

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As an example, one half of a bundle of steel wire was patented by heating to 1650°F as the wire advanced from the contact pan to the lead quench pan. The molten metal in the lead pan was maintained at a temperature of 975°F. and the wire was kept at this temperature for 18 seconds and was then air-cooled.

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The wire, so treated, presented a structure having a fine grain, and had the following physical properties:

Elastic limit	**84,000 Psi**
Yield Point	**105,200 Psi**
Tensile Strength	**158,000 Psi**
Elongation on 10 inches	**11.5%**
Reduction in area	**62%**
Rockwell hardness	**C 26-28.**

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The wire was drawn from 0.0915″ to 0.0175″ in the following steps:

(1) drawn from 0.0915: to diameter in 6 drafts to 0.0315″ diameter

(2) then copper coated and drawn in 7 drafts through continuous machines to 0.0175″ diameter.

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The physical properties of this wire after thus drawing were as follows:

1st end—Tensile strength 354,000 Psi
Torsions in 8 inches 101-108 Twists
Last end—Tensile strength 350,000 Psi
Torsions in 8 inches 105-106 Twists

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Another half of the same bundle of wire was "patented" by conventional methods. In contrast with the similar wire which had been treated by the electric direct resistance method, the physical properties of this wire were as follows:

Elastic limit	**68,400 Psi**
Yield point	**89,100 Psi**
Tensile strength	**146,500 Psi**
Elongation on 10 inches	**9%**
Reduction in area	**29.2%**
Rockwell hardness	**C. 31-34**

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A comparison of fatigue properties of wire drawn from wire patented by the Electric Direct Resistance Method and by the use of a conventional gas fired furnace using a salt bath quench is shown in Table 1.

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This new technique of heating wire through its own electrical resistance has made great commercial progress as a heat treating

TABLE I

COMPARISON OF FATIGUE PROPERTIES OF WIRE DRAWN FROM STOCK PATENTED BY ELECTRIC DIRECT RESISTANCE METHOD AND BY THE USE OF THE CONVENTIONAL GAS-FIRED FURNACE USING A SALT BATH QUENCH

ENDURANCE OR NO. OF REVERSALS OF STRESS REQUIRED TO FRACTURE WIRE

Alternate Bending Stress in lbs. per sq. in.	0.0485" Dia. Wire Drawn from stock Patented by Elec. Dir. Resis. Method	0.67% Carbon Steel Drawn from stock Patented by the Conventional Method	0.0675" Dia. Wire Drawn from stock Patented by Elec. Dir. Resis. Method	0.81% Carbon Steel Drawn from stock Patented by the Conventional Method
110,000	19,000	14,400	19,400	12,200
105,000	22,400	17,400	21,700	15,000
100,000	26,000	21,000	24,500	18,000
95,000	31,000	25,500	28,000	22,000
90,000	37,000	31,000	32,000	26,500
85,000	46,000	37,000	36,400	33,000
80,000	57,000	45,000	42,000	40,500
75,000	74,000	55,000	50,000	51,000
60,000	107,000	67,000	62,000	64,500
65,000	225,000	80,000	83,000	83,000
60,000	Indefinite	100,000	155,000	110,000

Wire Designation	Fatigue Limit or Limiting Fatigue Stress In Lbs. Per Sq. In.
0.0485" Dia. Wire - 0.67% Carbon Steel - Drawn from Stock Patented by the Direct Electric Resistance Method	63,000
0.0485" Dia. Wire - 0.67% Carbon Steel - Drawn from Stock Patented by the Conventional Method	45,000
0.0675" Dia. Wire - 0.81% Carbon Steel - Drawn from Stock Patented by the Electric Direct Resistance Method	57,000
0.0675" Dia. Wire - 0.81% Carbon Steel - Drawn from Stock Patented by the Conventional Method	49,000

method for "patenting". Its novel step quenching cycle produces a structure in which the microscope is totally unable to show any vestige of ferrite or of carbide plates.

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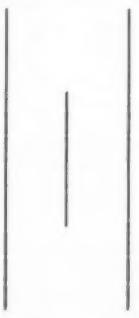
The resulting properties include a higher tensile for a given torsion, and a much higher uniformity in torsion tests.



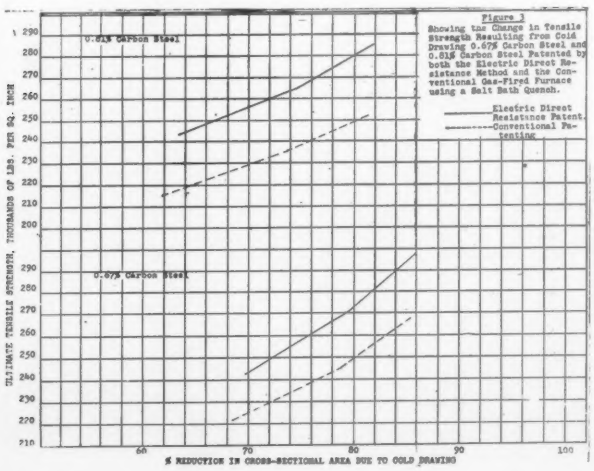
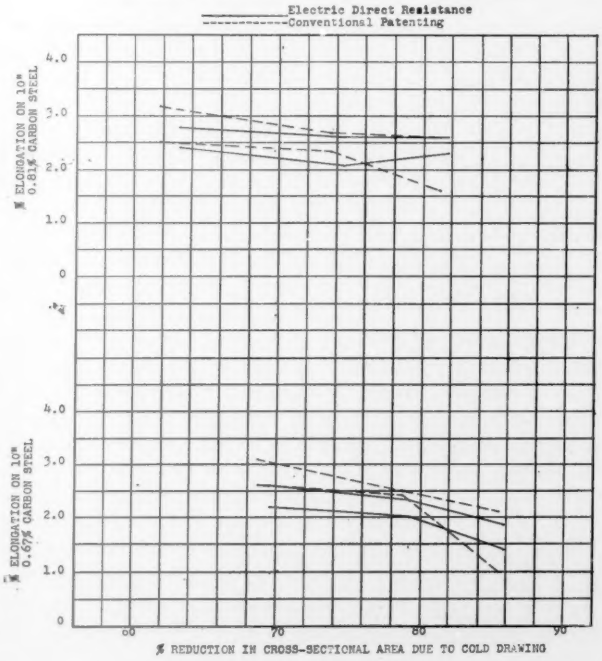

0.81% Carbon Steel
0.67% Carbon Steel
ULTIMATE TENSILE STRENGTH, THOUSANDS OF LBS. PER SQ. INCH
% REDUCTION IN CROSS-SECTIONAL AREA DUE TO COLD DRAWING
Electric Direct Resistance Patent.
Conventional Patenting

Figure 3
Showing the Change in Tensile Strength Resulting from Cold Drawing 0.67% Carbon Steel and 0.81% Carbon Steel Patented by both the Electric Direct Resistance Method and the Conventional Gas-Fired Furnace using a Salt Bath Quench.

Figure 4
Showing the Change in % Elongation on 10" Resulting from Cold Drawing 0.67% Carbon Steel and 0.81% Carbon Steel Patented by both the Electric Direct Resistance Method and the Conventional Gas-Fired Furnace using a Salt Bath Quench.


Electric Direct Resistance
Conventional Patenting
% ELONGATION ON 10" 0.81% CARBON STEEL
% ELONGATION ON 10" 0.67% CARBON STEEL
% REDUCTION IN CROSS-SECTIONAL AREA DUE TO COLD DRAWING

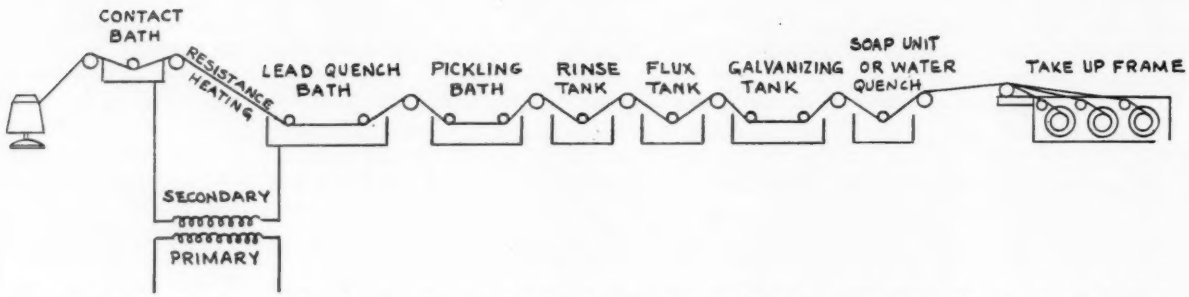


Figure 5

Tensile Properties of Wire

Figure No. 3 shows the average tensile strength of the wire cold drawn from electrically and conventionally patented wire after the third, fourth, and fifth or final drafts. From a study of these curves, it is apparent that a higher tensile can be obtained with a given material and a given drawing practice by resorting to electric direct resistance patenting.

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In Figure 4 it can be seen that the average percentage elongation on 10″ obtained from both the 0.67% Carbon and the 0.81% Carbon steel wires drawn 5 drafts from electrical patented stock is higher than that of the corresponding wires drawn from conventionally patented stock. The range in elongation of the wires drawn 5 drafts from electrically patented stock is, also, the narrower. The values on the curve are the minimum and maximum obtained as a result of a number of tests made upon the wire at the various stages of drafting.

Pickling—Fluxing and Galvanizing in Line with Electric Direct Resistance Heating

Because there is an absence of scale when wire is heat treated by the electric direct resistance method, pickling or cleaning of the wire can easily be done in line with the patenting operation.

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This can be either an ordinary acid cleaning method or it can be done electrically by connecting a direct current supply to the positive terminal which will feed the current to the wire and by connecting the negative terminal of the electrical supply to the cathode in the cleaning tank.

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The wire can then be rinsed, fluxed and if desired, galvanized in the usual manner as shown diagramatically in Figure 5.

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In conclusion the Electric Direct Resistance Method may be summarized as follows:

1. The Electric Direct Resistance Method of heating and quenching of the wire or strip at the split second moment that the optimum temperature has been reached produces a product with an extremely fine grain structure that results in the maximum strength, drawability, or further cold working capacity of the wire or strip.

2. Through a combination of extremely fast electric resistance heating, combined with an accurately controlled step quenching method, precise results are obtained which cannot be obtained by other methods.

3. The very rapid and uniform heating made possible by using an electric current passed directly through the wire or strip being heat treated cannot be duplicated by ordinary furnace or other heating methods. This rapid heating is uniform throughout the cross section, and results in an extremely tough, fine grained structure in the finished material. A two step quenching method is employed to bring the material to its transformation or hardening temperature. This makes it possible to correlate the best possible quenching speed to the material being hardened. There is no surface decarburization, and there is no scale. The control of both heating and quenching cycles is fully automatic and extremely accurate.

4. The Electric Direct Resistance Method is so versatile that on a single unit the following heat treating operations can be accomplished:

A. Oil tempering

B. Patenting

C. Annealing of high or low carbon and stainless or alloy steels.

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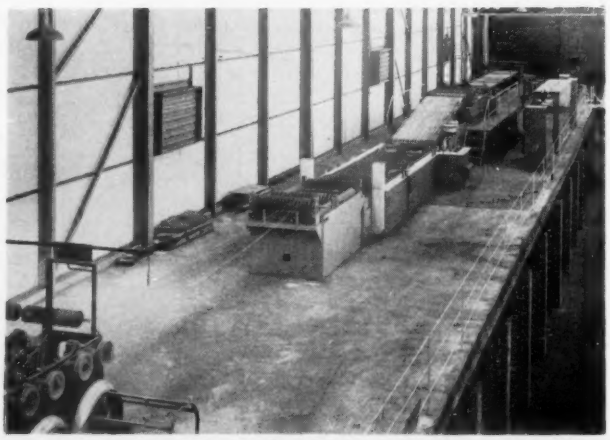
Cut No. 1 shows a typical installation of the Electric Direct Resistance heat-treating machine on which all of the aforementioned operations are accomplished.

5. The Electric Direct Resistance Method by the very nature of its operation, lends itself to "flow line" wire and strip production techniques which is the trend in industry today.



Cut No. 1

Weighing Samples of Wire to Determine Accurately the Hole Size of Fine Gage Diamond Dies

by

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Chief,
Wire Engineering Dept.

and

G. M. McLeod
Product Engineer,
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Western Electric Company
Tonawanda, New York

The growing demands for fine gage copper wire, together with the necessity for extreme accuracy have outdistanced the mechanical methods for quickly and reliably measuring the diamond drawing dies or the wire itself.

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The Tonawanda Plant of Western Electric produces over 20 million miles of fine copper wire annually. Some of this wire is as small as .002" in diameter. The tandem drawing machines reduce the copper cross section as many as 16 gages in one operation at nearly a mile a minute. To do this job over 10,000 diamond dies are resized annually.

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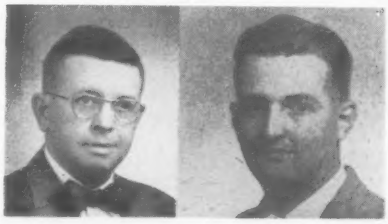
The standard tolerance on copper wire diameter and consequently on the dies is plus or minus 1 per cent of the nominal diameter in sizes to 0.010 inch (30 gage). Wire smaller than this has a tolerance of plus or minus 0.0001 inch. This provides a linear relationship for diameters that vary geometrically.

★ ★ ★

Investigations into wire tolerances showed that at the present time it is impractical to provide a non-linear decrease in tolerance to match the decrease in gage sizes. However, it was decided that the quality of the apparatus using the wire could be improved by cutting in half the allowed wire tolerance of some of the fine gages. The tolerance of plus or minus 0.00005 inch on the nominal wire diameter was established for wire sizes from .005 inch diameter and smaller.



W. R. Moyers G. M. McLeod

A paper prepared for presentation at the Annual Convention of The Wire Association in Chicago on October 15, 1957. **Mr. Moyers holds a degree of B.S. in M.E. from the University of Texas. He entered the employ of the company in 1929 and spent 18 years at the Hawthorne plant as Engineer of Copper Rod and Wire Manufacture. Mr. McLeod has a degree of B.S. in M.E. from Northeastern University. He joined W.E. in 1955, having formerly worked for Design News Magazine.**

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The standard tolerance of plus or minus 0.0001 inch was not too serious a problem in the measuring of die diameters. A length of wire one gage size larger in diameter than the die being checked was drawn through the die opening. This specimen was then measured for size and roundness with a barrel type micrometer. These micrometers can be maintained to hold an accuracy of 0.0001 inch. This was really not a satisfactory control for the standard tolerances. Several readings were taken as the wire specimen was rotated between the micrometer anvil and spindle. The average reading was the wire gage or size and the roundness was indicated by the spread of the readings. When the tolerance was reduced to plus or minus 0.00005 inch, it became impossible to accurately measure wire diameter with a screw type micrometer.

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Other methods of measuring were investigated. These ranged from electronic comparators to light waves. All had one or more faults that prevented their use in a production operation that required accurate information obtained by semi-skilled operators in the least possible time and under conditions detrimental to delicate apparatus. Operation conditions and measurement accuracy set the limits for any method or system of measuring wire diameters. A few of these conditions were that it should withstand a reasonable amount of abuse and still maintain its accuracy, require a minimum amount of maintenance, and be used by an operator after a brief instruction period.

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A method that appeared to fulfill all of these requirements was that of weighing a measured length of sample wire. Using standard physical constants, this was a relatively simple procedure. The first step in setting up this method was to make certain basic assumptions. The first was that the density of copper was 8.89 gm/cm^3 at 20° C. as stated in the International Annealed Copper Standard. Even though density varies slightly in copper from dif-

Fig. 1—The Die Shop measuring equipment for fine gage wire has flexibility. The various gages of supply wire are arranged on a rack for maximum convenience. Dies being checked are threaded with wire and placed in the die holder. The wire sample is taken, weighed and compared to the gage weight chart and recorded on the die envelope. * * *

Fig. 2.—Heavy gage wire is pulled through the larger size diamond dies by this rack and pinion and pulling jaw. Samples are weighed; compared with the master chart and recorded on the envelopes containing the dies.

ferent regions, this difference would not be apparent or measurable in copper from a production operation. Other constants used were 1 meter = 39.37 inches, 1 pound = 453.59243 grams.

From there: $W = d^2 \times \frac{\pi}{4} \times 8.89 \times \left(\frac{100}{39.37}\right)^3$

$W = 114.418275d^2$

Where: W = grams per inch of wire length

d = wire diameter in inches.

★ ★ ★

Using this formula it was a simple matter to compute the weight of a known length of any diameter wire. The theoretical American wire gage diameters were calculated and used in this formula.

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This gave a table of weights for each gage size. The wire tolerances were calculated in the same manner using plus and minus 1 per cent for 35 gage and larger and plus and minus 0.00005 inch for the fine gage wire.

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The average diameter of a wire produced by a die could now be determined by weighing measured lengths. However, experimental trials weighing wire produced by a wire drawing machine as compared to wire pulled through the same finish die by hand brought to light a variation in the two weights. It was established that this variation was because an operator could not pull a relatively long wire sample through a die by hand without varying the pull on the wire.

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To overcome this problem in the Die Shop a simple hand powered wire drawing machine was made. This consists of a die holder, a pulling capstan and a measuring wheel, with the capstan and measuring wheel driven together. (See Figure 1) Diameters of the refinished diamond dies are checked on this machine by drawing a wire of the next larger gage through the die opening. It is then wrapped around the capstan and fastened to the measuring wheel. The sample is taken by turning the measuring wheel the number of turns as specified on the master chart for the gage size being checked. A slot in the measuring wheel is provided so that the turns of wire are cut simultaneously. This provides several lengths of wire of exactly the same length. The number of samples or total length of sample wire varies with the diameter. By doing this, sample weights are produced that fall within the range of the precision balance used for weighing the sample.

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With the average wire diameter determined accurately by weight, the roundness is checked with a barrel micrometer, the same type previously used to determine the diameter. This instrument is sufficiently accurate to measure the roundness of the wire since in this case the micrometer is being used only as a comparator and not for measuring absolute values.

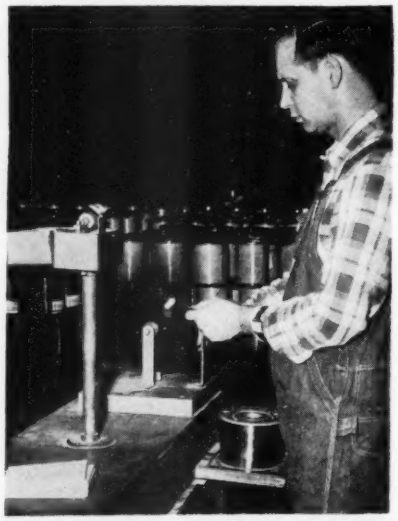

Fig. 3—Inspection of diamond dies in the Wire Mill is facilitated by mounting all of the inspection equipment except the torsion balance on a cart that may be moved to the wire drawing machine being checked. * * * * * * * * *

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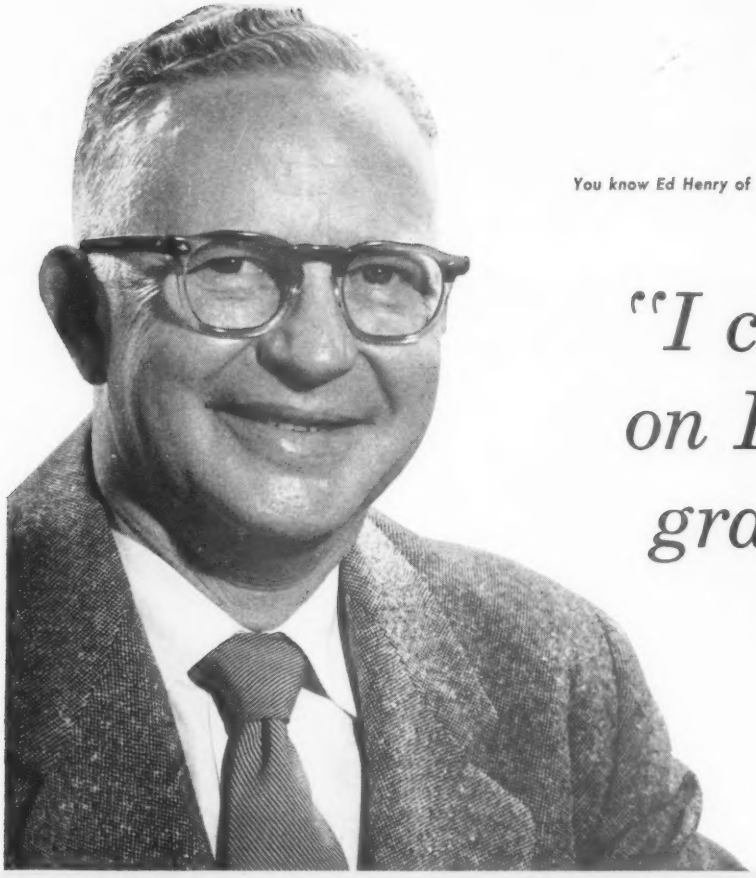
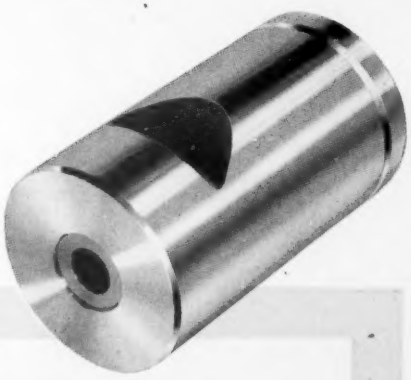
Although this system was developed primarily for fine gage wire, a second wire sample machine was made for the intermediate wire sizes so that all diamond dies could be checked by this method. The design of this second machine differs from the fine wire machine in that the wire is pulled through the die by a clamping jaw actuated by a rack and pinion. Sample lengths are cut by tungsten carbide shears operated simultaneously. Only one length of the larger diameter wire

(*Please turn to page* 1273)



You know Ed Henry of Hedalloy Die Corporation. He says . . .

"I can rely on ELGIN grading"



. . . and precision grading is a must for highly finished work surfaces where scratches cannot be tolerated.

The inset illustration shows the world's largest boltmaker die, made by Hedalloy Die Corporation—one foot long and nearly seven inches in diameter! Because a single scratch during finishing would mean a loss of countless hours of work, Hedalloy specified Elgin Precision Graded DYMO-C* . . . to be sure.

*C for carbide

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The History of and New Developments in Wire Packaging

by Fred J. Bieber, President
Acrometal Products, Inc.
Minneapolis, Minnesota

Never in the history of the wire industry has the packaging of wire received so much interest and consideration as it has in the past three to five years. The entire industry, both the ferrous and nonferrous groups, has realized the importance of this phase of their operations. The wire maker has carried on year in and year out, content with the fact that he was giving his customer the best possible package attainable and that there was little if any need to waste time and money to improve the basic principles involved to try to come up with a new departure from the packaging principles which the industry has lived with for years on end. Both the wire maker and the wire user were cognizant of the fact that vast sums of money were being spent every year for freight in shipping reels and spools back and forth between the plants of the wire producer and the wire user. The user was never happy about this condition because he fully realized that in most instances he was standing the cost of the freight, either directly or indirectly, and, in addition, vast sums of money were being tied up each year in reel and spool deposits. Most of the larger users of wire objected to this fact very strenuously. Everyone connected with the wire industry realized that as time went on and new developments and materials came into being, and as industrial science throughout the world progressed, the day would ultimately come when improvements in wire packaging would overcome these conditions. However, there were no concerted efforts on the part of either the maker or the user to push the matter with force.

Fred J. Bieber

A paper prepared for presentation at the Annual Convention of The Wire Association in Chicago on October 15, 1957. **The author is a graduate Mechanical Engineer from the University of Rochester. He started his career as a tool and die maker and tool designer and became Chief Tool Engineer of the V & O Press Company. In 1940 he joined Scovill Manufacturing Company in an executive engineering capacity and after World War II became associated with Remington Rand, Inc. as manager of their General Process Engineering Division. Later he became associated with Casco Products Company as Vice President in Charge of Manufacturing. He joined Acrometal in 1951 as Vice President and General Manager and was shortly thereafter elected a director of both Acrometal and the U. S. Bobbin and Shuttle Co. In 1953 he was made president of Acrometal Products.**

Through the years, up to and including the years of World War II, the bulk of the heavier gauges of non-ferrous wire was shipped in coils and the finer gauges of wire were shipped on spools and reels made of steel, wood, or a combination of wood-metal. The ferrous producers shipped the bulk of their wire in coils or bundles and the small percentage of wire that was spooled, was packaged on the same type of package that the non-ferrous industry was using. In most instances the spools and reels that were being used were of the same construction as the spools and reels that the mill operator was using for drawing and annealing purposes. This meant that they had to be rigidly constructed which embodied weight and bulk. The handling of these packages was a problem to both the wire manufacturer and the wire user. In a good many instances the ratio between the tare weight of the spool or reel and the amount of wire being packaged was not too great a margin and staggering sums of money were being spent for freight in shipping the package loaded with wire and returning the empty package to the wire producer. In addition, the wire producer was faced with an annual cost which ran into considerable sums of money to keep these spools and reels in repair and condition so that they could get sufficient trips out of this equipment to warrant at least a breakeven figure on their investment in the initial purchase of this package equipment.

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The first major change in wire packaging in a good many years came about in the years following World War II when the aluminum spool and reel were introduced to the industry. Here the industry was offered a package that was as rigidly constructed as the equipment that they had been using over the years and at a cost that was economically sound. The tare weight of these spools and reels was a minimum of one-third of the weight of the spools and reels that had been used in the past, which automatically reduced freight costs in shipping. In addition, the design and construction of these packages were such that greater accuracy and balance could be embodied into their design which enabled the wire producer, especially the producers of fine wire, to realize new economies in his operation. These

spools were held to close dimensional tolerances which automatically eliminated numerous spooling problems and also enabled the wire manufacturer to step up his operating speeds. The weight of these spools and reels was also held to close tolerances which introduced the possibility of bulk weighing—a factor almost unheard of in the industry heretofore and a factor by which the wire maker realized additional economies. The fact that aluminum has certain properties and appearance made it possible to glamorize the appearance of the package and brought about a condition that the mill operators and users, in a vast number of cases, handled this equipment with a great deal of respect which cut spool maintenance costs. Companies adopting the aluminum spool and reel were, for the first time in the history of the industry, able to put their wire up in a really attractive package which put them into a better competitive position. Almost overnight the users of wire realized that this aluminum package had a lot to offer and in a good many instances users specified that their wire should be packaged on this type of package. The user found that he was getting a package that was uniformly wound and a package that his operators could easily handle. In addition, the amount of scrap wire on spools was drastically reduced. The aluminum spools used for the finer wires were constructed such that the head of the spool is an integral part of the barrel which absolutely eliminated wire trapping at the joint where the head of the spool joins the barrel. Wire trapping had been a constant headache to both the wire manufacturer and the user.

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With the introduction of the new precision aluminum package the wire manufacturer began to experiment with his packaging because he realized that with this new jewel he could accomplish what heretofore everyone felt was impossible. As a result, larger packages became a reality. Manufacturers were known to process wire as fine as #40 or #42 successfully in volume weight up to 60 or 70 pounds. All of the accomplishments which became a reality with this aluminum spool and reel were the beginning of a new evolution in the field of wire packaging.

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The introduction of the aluminum spool and reel eliminated a lot of problems for the industry as far as the smaller packages are concerned, however, in this new era of packaging the entire industry began to realize that only a small surface had been scratched by the new package and that something had to be done to make the packaging of heavier wire and heavier packages more attractive from an economy standpoint to both the wire maker and the user. In addition, as the years went on, developments in new high speed equipment brought about the need for larger packages of wire. The entire wire industry realized that this problem of packaging was important and much thought and effort from various channels from within the industry was devoted to development of new ways and means of meeting this demand. For many years the wire people had dreamed of a wire package that would be disposable once the user had removed the wire. Over a period of years several ideas and plans were considered and explored.

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The wire manufacturers did considerable research to establish a cost figure that they could afford to economically put into a package that would be non-returnable. Most reports established that one penny per pound of wire packaged was about the maximum figure that the wire maker could economically put into a package that would be non-returnable. This took into consideration the cost of the package against the savings in return freight, maintenance, handling, and bookkeeping. As a result of this extensive research program, most of which was devoted to the making of spools and reels of a material that was less expensive than those materials in use, there seemed to be no outstanding recommendations whereby the industry could economically afford to discard their method of packaging on the returnable type of package. Finally, as a result of the combined efforts of a drum manufacturer, an equipment manufacturer, and a wire manufacturer, came the startling announcement that it was possible to package wire in a drum type container at a cost that was economically practical to the wire maker. It further developed that this type of container would be disposable which was to the advantage of the wire maker as well as the user.

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This announcement opened a new era in the packaging of wire. 600 to 1,000 pounds of wire was being successfully packaged in fibre drums which cost less than $5. Several sizes of packages came into being, ranging in capacity from 90 to 100 pounds up to the larger packages previously mentioned. This method of packaging was, without a doubt, successful as far as the packaging of the heavier gauges of wire was concerned. The big user began to demand that his wire be packaged in buckets or drums because he felt that it was now possible to get larger packages than they had ever dreamed of and, in addition, he had realized his dream of what he felt was a practical non-returnable, no deposit package. In a good many instances the wire maker was forced into this type of package in order to remain competitive.

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Here we had a new phase of packaging. However, there were new problems to both the user and the wire maker which came into being with this new method of packaging which was an absolute departure from what the industry had been accustomed to over the years. In both the plant of the wire maker and the plant of the user their people had, since the beginning of the industry, been used to handling spools and reels. The introduction of the drum presented the user with a problem of handling and storage and, in addition, changes had to be made to the machine equipment in their plant to accommodate this new package. In some instances these changes in equipment entailed sizable ex-

(*Please turn to page* 1283)

A Weldable, Hardenable 12% Chromium Alloy

by W. R. Kegerise
Metallurgist — Development
The Carpenter Steel Company
Reading, Pennsylvania

Introduction

Considerable difficulty has been experienced in welding and casting in hardenable 12.00% chromium alloys. Cracking in the weld area and embrittlement in the heat affected zones are two of the most serious problems. To avoid cracking, pre-heat and post-heat treatments are necessary. High hardnesses resulting from the welding operations necessitate an anneal or a high temperature stress relief for further machining or forming operations. Delta ferrite or "chrome ferrite," are also formed in many of these alloys when subjected to the high temperatures of welding. This ferrite lowers the general ductility and in particular impact strength. Because of the low ductility, it has been impossible heretofore to weld and draw 12.00% chromium alloys into wire in a continuous operation.

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Essentially, non-hardenable alloys containing aluminum and columbium, Type 405 and Columbium Ascoloy, are being used successfully to avoid cracking; however, during the welding operations, extreme grain coarsening occurs. These alloys have a mixed structure of approximately 50% martensite and 50% ferrite. Upon welding or casting, extremely large grains of ferrite are formed, which have low impact strength and tend to crack in service at the interface of the two phases.

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One of the applications for a good weldable or castable alloy is in steam turbine diaphragm assemblies where the blades are welded or cast in place. Tie-wires are also welded to the large buckets to decrease vibration due to the impulse of the steam. Our development program was aimed at developing an alloy for these applications.

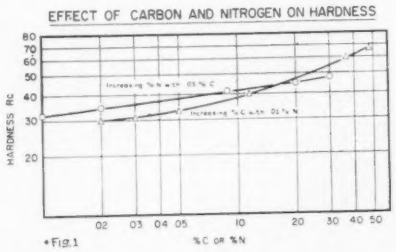
W. R. Kegerise

A paper prepared for presentation at the Annual Convention of The Wire Association in Chicago on October 15, 1957.

The author studied metallurgy at Lehigh University and entered the employ of Carpenter Steel in 1949 in the Metallurgical Laboratory, being assigned to work on valve steels and high temperature alloys. At present he is in charge of high temperature and special alloy development. He has filed several patents on high temperature alloys, principally in the category of those stainless steels discussed in this paper.

Alloy Development

It was thought that an alloy having a fully martensitic structure which would have a maximum as-quenched hardness of Rc 36 might solve the problem. From our experimental work, it was found that the carbon and nitrogen contents must be kept low in order to maintain a low hardness level. For practical purposes, the carbon should be kept at a maximum of .06 and the nitrogen to .03, or a sum of carbon and nitrogen of .08%. By keeping the carbon and nitrogen contents low the hardness is kept to a minimum and treating stresses from transformation are low; thereby preventing cracking. With the low carbon and nitrogen contents, the retention of carbides and nitrides from treating are also eliminated. Nehrenberg also found that carbon and nitrogen are responsible for the attainable hardness in chromium martensitic steels. Our data agree with their published curves. Fig. 1 taken from this paper shows the effect of increasing hardness with increasing carbon contents with a constant level of .01% nitrogen, as well as with increasing nitrogen contents with a constant carbon content of .05%. Here it can be seen that in order to keep the hardness below Rockwell C-36, the nitrogen must be kept below .03% with a carbon content of .05% or the carbon content kept below .08% with a constant nitrogen of .01%.



•Fig.1

Carbon and nitrogen are strong austenitizing elements. Because they are limited to very low amounts in order to meet the hardness requirements, other austenite forming elements must be added to insure a fully martensitic structure after treating or welding. In our program nickel and manganese were used to attain a fully martensitic structure. Approximately 1.50% nickel is required for the desired structure when the manganese content is approximately .40%. As the manganese is increased, less nickel can be used and can be replaced by approximately 2.25% manganese. However, as the manganese is increased the impact strength of the alloy is lowered. For general purposes the manganese should be below 1.0% and

the nickel approximately 1.5%. When better fluidity is needed for casting or welding, higher manganese contents can be used.

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The alloy which has the desired properties is of the following composition:

C	Mn	Si	Cr	Ni	N
.035	.50	.30	11.7	1.5	.02

Material

Several heats were processed into bars ⅝" round, 5/16" x 2⅛" rectangles, ¾" square, and wire ¼" diameter which was used for cold drawing experiments. Bars 2" x 3" and 1¾" x ½" were processed for fabricating into steam turbine buckets and blades, respectively. The analyses of these heats are shown in Table I. Heats with the prefix "B" are 60-pound experimental high-frequency induction-melted, and the "O" heat is a 2000-pound induction-melted heat.

TABLE I

ANALYSES

Heat No.	C	Mn	Si	Cr	Ni	N
B-02398	.033	.48	.32	11.68	1.45	.022
B-02641	.044	.49	.29	11.47	1.45	.021
B-02652	.054	.49	.25	11.43	1.61	.025
O-11970	.038	.65	.35	11.30	1.72	.023

Mechanical Properties

Effect of Temperature on Hardness:

In order to simulate the effects of welding temperatures, specimens from heat B-02398 were exposed to temperatures from 1700°F to 2300°F, oil-quenched and tempered one hour at temperatures from 200°F to 1200°F. The results of these tests are shown in Table II. Here it is shown that the hardness level of Rc 30/33 is held constant over the entire hardening range. When tempering, the hardnesses are also constant up to 1000°F. Above 1000°F, the hardness falls off rapidly.

TABLE II

EFFECTS OF TREATING AND TEMPERING TEMPERATURES ON HARDNESS

Tempering Temperature	Treating Temperature: 1700	1800	1900	2000	2100	2200	2300
	Hardness						
As Quenched	32 Rc	32 Rc	31 Rc	32 Rc	32 Rc	31 Rc	30 Rc
200°F	32	32	31	31	31	31	31
400	32	32	32	32	31	31	32
600	32	32	32	32	32	32	32
800	32	33	32	33	33	33	32
1000	31	31	32	32	31	31	31
1100	96 Rb	96 Rb	96 Rb	96 Rb	95 Rb	95 Rb	94 Rb
1200	93	93	93	93	92	92	92

Tensile and Impact Properties:

Tensile and impact properties of the alloy are shown in Fig. 2. These are room temperature properties after oil treating from 1750°F and tempering at temperatures of 300°F to 1100°F. Tensile strengths of 160,000 psi are maintained with tempering temperatures up to 900°F. Yield strengths of approximately 130,000 psi are maintained up to the same temperature. Above 900°F the tensile and yield strengths fall rapidly. Good ductility as measured by percent elongation and reduction of area is attained over the tempering range and increases steadily with increasing tempering temperature.

EFFECT OF TEMPERING TEMP. ON CARPENTER ALLOY

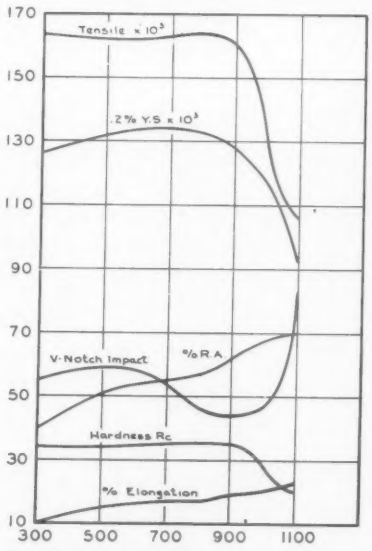

Fig. 2 TEMPERING TEMP °F

V-notch Charpy impact tests also indicate that the alloy has good ductility. A decrease in impact strength is noticed in the tempering range of 800° to 1000°F. These results indicate that the alloy has a good balance of strength and ductility.

Stress Rupture Properties:

Stress-rupture properties were determined at temperatures of 850°F to 1150°F on specimens .252" in diameter with a 1 inch gage length. Results are plotted on a time-temperature parameter versus stress as proposed by Larson and Miller. These properties are shown in Fig. 3, compared with Type 405. As can be seen an improvement at all levels is realized.

STRESS RUPTURE PROPERTIES OF CARPENTER ALLOY VS. TYPE 405

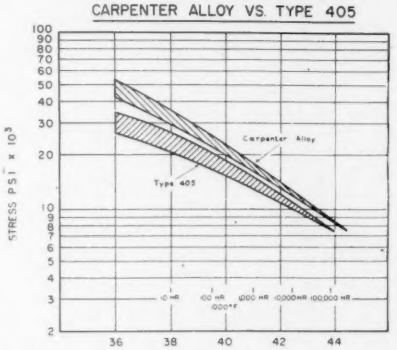

Fig 3 P = T(25 + LOG t) x 10⁻³

Table III shows the results of these tests with accompanying ductility values. From the elongation and reduction of area measurements, the alloy exhibits very good ductility. Although the tests are relatively short time tests, embrittlement with exposure to temperature within these times does not exist.

TABLE III

STRESS RUPTURE TEST RESULTS

Heat No.	Test Temp. °F	Stress psi	Time Hrs.	Elong. %	RA %	Treatment
B-02398	1000	40,000	4.3	35	79	1
"	1000	30,000	28.0	33	81	1
B-02641	850	46,000	216.0	28	73	2
"	850	41,000	530.0	26	69	2
"	900	35,000	195.0	35	69	2
"	1000	50,000	0.9	26	74	2
"	1000	25,000	60.0	40	73	2
"	1000	20,000	336.0	43	68	2
"	1050	50,000	0.6	24	73	1
"	1050	40,000	3.5	27	71	1
"	1050	30,000	17.0	41	74	1
"	1050	27,000	5.0	21	73	2
"	1050	20,000	42.0	26	69	2
"	1050	16,000	174.0	24	68	2
"	1150	10,000	101.0	49	75	2

(1) 1 hour 1750°F. - oil quenched, 1 hour 1050°F air cooled.
(2) 1 hour 1800°F - oil quenched, 1 hour 1050°F air cooled.

Welding Tests:

A weld bead was laid by hand on the ⅝" round bar from heat B-02641 without preheating. A non-consumable tungsten electrode with an argon protective atmosphere was used. No cracks nor free ferrite were evident upon examination.

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Butt welds using the non-consumable tungsten arc-argon atmos-

phere, and a filler weld bead of 310 stainless-coated rod were made on the 2⅛" x 5/16" flat bars from heat B-02652. The argon-arc butt welded pieces were jigged tightly together to insure a restrained weld. A weld bead was laid on both sides of the bars in an attempt to have weld metal completely through the joint.

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The filler metal welds Type 310 were made in three passes to completely fill a 60° V-notch.

★ ★ ★

Macro- and micro-examination of both type welds did not show any cracking. The structures are free of delta ferrite. Fig. 4 is a microphotograph of the weld and heat affected area on the tungsten argon-arc weld. Fig. 5 shows the structure of the weld using the 310 stainless filler rod. Very little diffusion is evident at the junction of the two alloys.

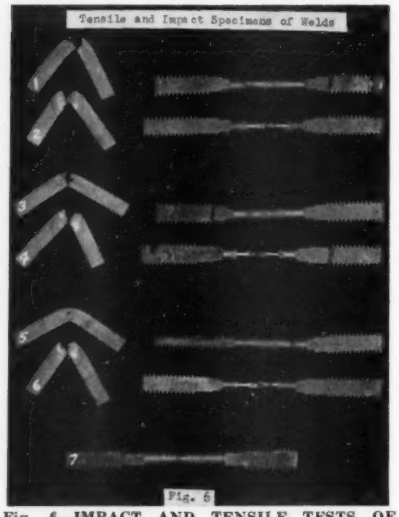

Fig. 6—IMPACT AND TENSILE TESTS OF CARPENTER ALLOY
Left Row—IMPACT (Cross Section)
Right Row—TENSILE (Cross Section)
#1 As welded butt weld
#2 As welded filler weld
#3 As welded and drawn 300°F butt weld
#4 As welded and drawn 300°F filler weld
#5 As welded and drawn 1000°F butt weld
#6 As welded and drawn 1000°F filler weld
#7 As welded—longitudinal section—butt weld

These tests indicate that the weld metal is ductile and strong.

Fig. 4
Weld and heat affected area of tungsten arc weld.

Fig. 5
Weld area with 310 stainless filler rod.

Tensile and Impact Tests of Welds:

Tensile and unnotched Charpy impact tests were made on the cross-section of both type welds. Specimens were tested as welded, as welded and tempered one hour at 300°F, and as welded and tempered at 1000°F. A tensile test was made on the longitudinal section of the argon-arc weld. This specimen was machined so that it consisted entirely of weld metal. Fig. 6 shows the fractured specimens. All of the odd numbered pieces are argon-arc welds, and the even numbers, the 310 filler welds.

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The argon-arc welded specimens broke just outside the heat affected area. The tensile strength reflects the strength of the unaffected area. The longitudinal test specimen of all weld metal, as welded, has a tensile strength of 151,000 psi, 15% elongation, and 52% reduction of area, which indicates that the weld metal is strong and ductile.

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All the specimens with the 310 filler metal fractured in the 310 weld area which indicated the base material is stronger than weld. The results of these tests are shown in Table IV.

★ ★ ★

Upset Butt Welding

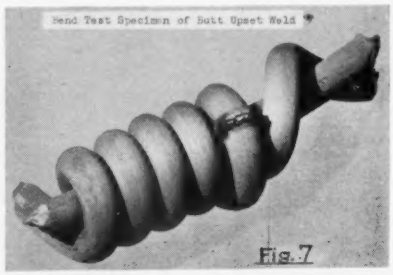
In order to further investigate the properties of the alloy after welding, wire .250" round was upset, butt welded, and cold drawn various percentages up to 85% reduction in area. The upset welds were made with a Micro Products Welder. The welding procedure was to prepare the rod end by grinding about ¼" radius which was then clamped in the welding dies for welding. The welds were cooled to black heat in the welding dies before removing. Fourteen welds were made, then annealed at 1200°F, and the upsets removed by grinding. To test the weld, the wire was wrapped around its own diameter without any cracking occurring either in the weld or the heat affected zone which is shown in Fig. 7. No pre-heat was used in welding.

TABLE IV

TENSILE AND IMPACT PROPERTIES OF WELDED SPECIMENS

Treatment	T.S.	% E	% RA	Unnotched Charpy Impact Ft. Lbs.
Argon Arc Welded Specimens				
as welded	107,000	10.6	51.8	87
as welded & temperd 300°F	111,000	7.6	50.8	35
- - + tempered 1000°F	109,000	11.2	54.0	100 +
* as welded	151,000	15.0	51.8	
Arc welded 310 Filler Rod				
as welded	91,000	12.4	42.0	73
as welded + temper 300°F	83,000	13.2	51.8	81
" " " " 1000°F	82,000	13.2	45.0	72

* longitudinal all weld metal specimen.



Cold Drawn Wire

The butt welded wire rod was then prepared by cleaning and lead coating for cold drawing. The ¼" round rod was successfully cold drawn to .098" without an in-

(*Please turn to page* 1258)

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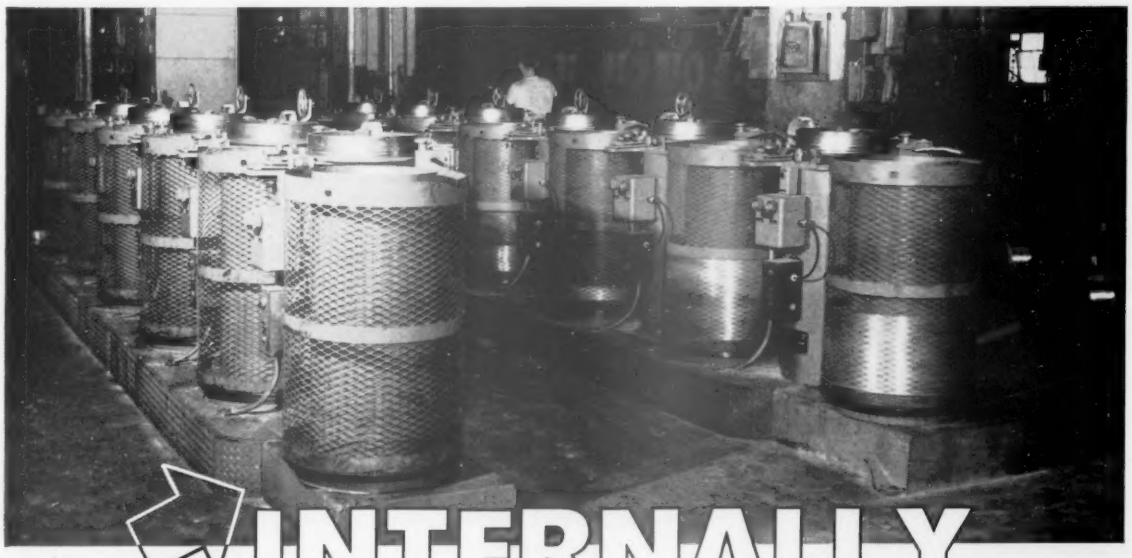

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Recent Developments in Steel Wire Drawing Machinery

by

James E. Spearman
Assistant to the President

and

Maurice A. Nye
Chief Engineer

Vaughn Machinery Company
Cuyahoga Falls, Ohio

James E. Spearman

This paper was prepared for presentation at the Annual Convention of The Wire Association in Chicago on October 15, 1957. Mr. Spearman is a graduate of the University School, Cleveland, and attended Yale University. He joined Vaughn in 1940 and was named to his present post in 1954. Mr. Nye started with the company in 1927. He has worked in the shop, the Engineering Dept. and Sales Dept. In 1949 he was appointed Assistant Chief Engineer and in 1954 named Chief Engineer.

Maurice A. Nye

During the past thirty-five years, tremendous strides have been made in wire drawing procedures and productivity. Many of the men here today have made significant contributions to that progress. Certainly, the Wire Association itself has performed an invaluable service to the industry by promoting a freer interchange of knowledge among competitors than existed prior to its formation.

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Naturally, as a major manufacturer of wire drawing machinery, we, too, like to feel that we have been highly instrumental in contributing to wire drawing improvements. But quite frankly, when we look at the record, as regards the progress achieved in certain other segments of the steel industry, we find that we have little or no reason to be smug. There is still much room for improvement.

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Today, Vaughn equipment is involved in four principal areas of attack, insofar as the improvement of wire drawing operations is concerned.

1. **Rod and wire preparation, as it pertains to Take-Up Frames.**
2. **Pre-drawing preparation, involving rod straighteners, pointers, reels, flippers, mechanical descalers, and general handling methods.**
3. **New machinery, involving improved electrical systems, increased working safety, and the updating of existing designs of machinery.**
4. **The actual taking up of the drawn wire in cartons, on spoolers, on standard or riding strippers, and subsequent transfer to carriers.**

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A conventional Take-Up Frame for patenting has multiple horizontal spindles operating at slow speeds, which coil the wires being pulled through the patenting furnace. With this arrangement, large bundles, in terms of today's demands, are not practical.

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Using existing furnaces, an alternative approach has been to use Vaughn Vertical Patenting Spindles, equipped with push-up blocks and riding strippers. (On the push-up blocks, a separated flange is canted with relation to the perpendicular axis of the block. As the block rotates, the flange pushes the wire up the block, leaving the entry surface always free for the oncoming strand.)

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Bundles weighing up to 4,000 lbs. are coiled quite successfully, and stripping can be accomplished on the fly by temporarily slowing down, but not stopping the block. Although the units are smaller, the same basic principle has been followed on galvanizing operations. Figure 1.

Fig. 1—Vertical Push-up Blocks for Galvanizing.

On the drawing boards is a 40-wire Inverted Block Take-Up Frame. The thinking behind this development is that large bundles can be coiled and then dropped on to loading pallets, effectively minimizing handling.

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Where twist in the finished product is not a factor, stationary or dead blocks, where the wire is laid on the block by means of a rotating flyer, are gaining wide acceptance. Figure 2.

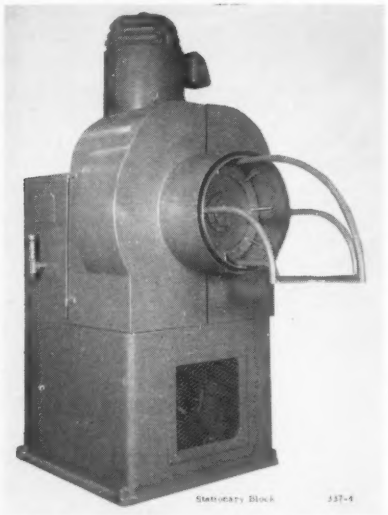

Fig. 2—Stationary Block.

Ultimately, a practical solution to the patenting problem may lie in high speed single strand patenting, whereby the product is rapidly patented in a special atmospherically controlled furnace, utilizing much less floor space than existing units, and is then cleaned, coated and taken up on a double spooler, or on a continuous coiler.

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A few years ago, a continuous coiler was developed, incorporating a double set of push-up blocks. The lower block revolves at a constant rate of speed, and the wire is transferred to the upper or stripper section of the block. The top section can be stopped for stripping purposes, and then can be accelerated to remove the wire that has been accumulated on the lower block during this operation. After this accumulation has been removed, the wire speeds of the two blocks are automatically synchronized. Certain simplifications in design are contemplated before this unit will be placed on the general market.

On large sizes, immediate predrawing preparation is one of the biggest headaches in the industry today. Vaughn recently developed a 3-Roll Straightener for straightening large rod sizes to facilitate pointing and threading through the die holder (Figure 3). After

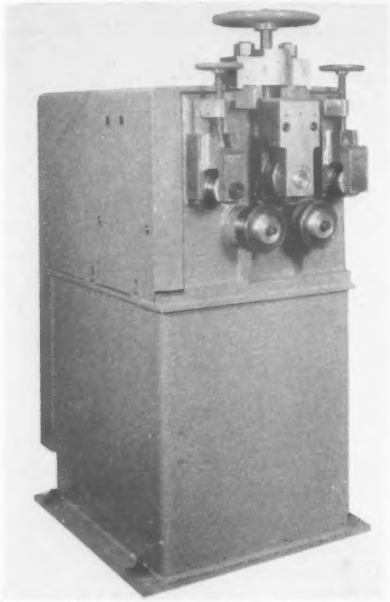

Fig. 3—3-Roll Rod Coil End Straightener.

pointing the straightened end on a king size Four-Roll Pointer (Figure 4), capable of accommodating a range of 1¼" diameter to ½", the coil is lowered on to a Floor

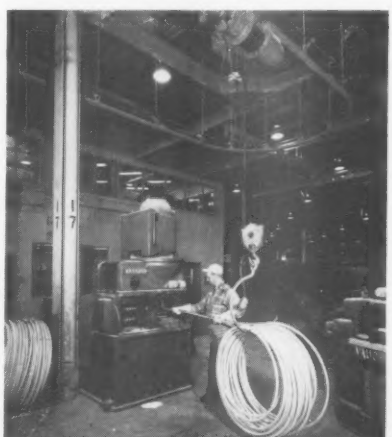

Fig. 4—Extra Heavy 4-Roll Continuous Pointer.

Reel with a Positioning Base (Figure 5) that permits the straightened and pointed end to be passed through the die for seizure by the grip, with less strain on the part of the operator.

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Another answer to this problem

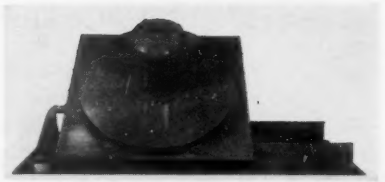

Fig. 5—Extra Heavy Floor Reel on Positioning Base.

may be the hydraulically operated Push Pointer recently supplied in conjunction with a Vaughn Motobloc for rod sizes ½" to 1¼". With this method, the rod is pointed and pushed through the die in one operation.

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As the drawing speeds have increased, flipping and pay-off problems have also multiplied. With definite floor space limitations in most plants, and some trend toward compressed bundles, various anti-snarl devices are receiving increased attention. Some people have achieved marked success by doing their high speed flipping through a barrel or with a sliding weight affixed to the strands being flipped. In at least one instance, a split ring snarl switch, which permits the snarl to pass through as the switch is tripped, provides enough extra travel to prevent the wire from breaking in the machine. Conceivably, overhead roller arrangements, as used in the nonferrous wire drawing industry, may come into vogue.

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With flippers themselves, there has been little change in recent years. Generally speaking, two flippers for each machine are placed side by side, and the end of one bundle is welded to the starting end of the other. Bundle diameters and flipper spacing, in a large measure, control machine spacing. The 3-way rotating flipper, while being specified by some people has not met with wide general acceptance. Figure 6.

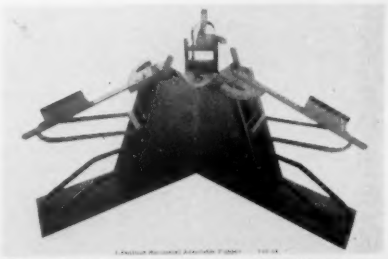

Fig. 6—3-Position Horizontal Adjustable Flipper, showing one position.

In order to talk about modern machinery, a brief history of wire drawing machinery, as it relates to the company's products, is necessary. Thirty-five years ago, practically all steel wire drawing was done one hole at a time on single speed rod frames, through chilled iron dies, at speeds up to about 350-FPM. The blocks were driven by cast teeth or cut teeth beveled gears, with jaw type, or friction type clutches connecting to a line shaft. Bundles weighing up to about 165 lbs. were bugger-lugged—to and from the blocks by hand—an arduous backbreaking job.

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In 1924, the Vaughn Single Spindle Motobloc was introduced. (Figure 7.) This was and is a

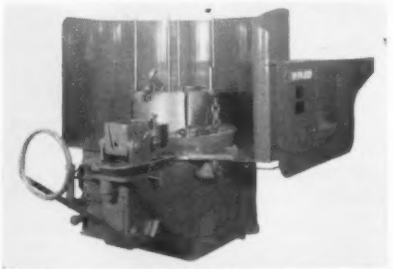

Fig. 7—Single Deck Motobloc.

simple machine, but it gave the wire industry a tool whereby wire drawing speeds increased from 300/350-FPM to 900 or 1,000-FPM. It consisted of a block driven through a set of worm gears by an adjustable speed, direct current motor mounted on a common bedplate. By the use of direct current, slow starting speeds were obtained with greatly reduced point breakage, and the automatic gradual acceleration to preset drawing speeds enabled much higher drawing speeds to be obtained, with the added advantage of being able to draw each size within the machine speed range limits at the maximum speed permitted by horsepower. Dynamic braking provided quick stops electrically, without the use of mechanical brakes.

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Initially, considerable resistance was encountered in selling this machine to the wire industry, not only because of its extra cost, but also because at the time, due to transmission costs, there was a reluctance on the part of the operators to use direct current in a wire mill. Today, however, one seldom finds a steel wire mill that does not use direct current power for its wire drawing operation. It is needless to add that the Motobloc proved itself, from a cost and production standpoint.

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The Motobloc, built in eight different basic models, is now used primarily for large sizes, all sorts of breakdown work, and finishing or sizing operations, or by mills whose production requirements do not warrant the investment required for continuous wire drawing machines. Many refinements of design, such as double decking, external air cooling, internal water cooling, the push-up block, and pintles for accommodating riding type block stripping spiders for large bundles, have been incorporated into the Motobloc. But the basic principles of this sturdy machine have remained essentially the same through the years.

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In the design stage, however, is a suspended type Motobloc for large sizes. This is being developed primarily because of the stripping disadvantages of the more conventional type on large sizes, and on high alloy materials where much springing out is encountered. Employing this principle, the finished coil can be dropped to a platform or conveyor.

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At about the time the Motobloc first appeared on the scene, accumulative type continuous wire drawing machines, having enjoyed some success in Europe, were being introduced in this country. Small bundles and chilled iron dies were still widely used, and because of rapid die wear and the length of time required to string up bundles, a battery of Motoblocs could outproduce or remain competitive with a continuous machine over a given range of finished sizes.

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In the early 1930's, the carbide die and major improvements in welders and welding techniques changed the picture considerably, insofar as the profitability of continuous wire drawing machinery was concerned. With the wide acceptance of the direct current Motobloc, it was a logical step to combine the individual motor principle into a machine of multiple spindles, suitably geared, with a tension arm between each spindle, around which a loop of the wire being drawn was used to control and regulate the speed of the preceding motor through a dancer rheostat.

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Thus, a truly continuous machine was obtained, one with no accumulation, no twist in the wire from block to block, and no slip between the wire and the block. The first continuous machine—our Motoblox—was designed for low carbon wire only, and for operation from a common 230-volt direct current, constant potential power source. This forerunner to the modern Motoblox was air-cooled only by means of an air ring around each block, plus a blast of air directed through passages within the block. It was designed for a fairly narrow range of drawing speeds, up to a maximum speed of 1200/1400-FPM. Originally, the worm drive was an integral part of the shaft of the flange mounted motor.

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Additional cooling of the blocks was indicated when the Motoblox was applied to the drawing of high carbon wire. Supplementing the external air cooling, internal water cooling of the blocks was added. Flange motor mounting was improved with a flexible coupling between the motor and the worm shafts.

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In subsequent years, a complete range of Motoblox has been developed. The largest, the HRX Motoblox (Figure 8) with 30″ diameter

Fig. 8—6-HRX Motoblox.

blocks and 98-HP on each spindle, is capable of reducing 7/16″ diameter high carbon steel to .192″ continuously at 800 or 850-FPM. Actually, it is designed to accommodate even larger sizes. The smallest of the Motoblox type is the 8-HFFV Motoblox, having 8″ diameter blocks, and finishing .025″ to .010″.

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Although classified in this same general category, the HRX Multiplex Motoblox (Figure 9) and the recently developed HRK Motoblox (Figure 10) vary somewhat in operating principle. The Multiplex is

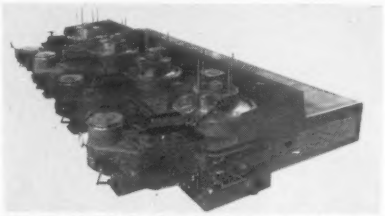

Fig. 9—4 HRX Quadruplex. * * * * * * * *

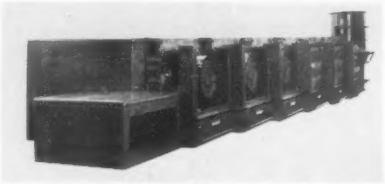

Fig. 10—7 HRK Motoblox. * * * * * * * *

electrically and mechanically arranged to operate as either a series of individual blocks, or as a tandem machine. The HRK Motoblox features unit construction, horizontal spindles of offset design, and no tension arms. Additionally several models of the Motoblox are built whereby non-slip drawing can be achieved in a bath of lubricant.

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As the demand for higher speeds grew, the over-all speed range of the Motoblox, as well as the top speed, was increased by using an adjustable voltage (Ward Leonard) direct current electrical power source. Usually, one large Motor Generator Set supplied the required adjustable voltage current to all motors of a single machine. By using 300 or 345-volt armatures, additional horsepower for the same size motor was obtained, which permitted sizes falling within the torque range of the machine to be drawn at faster speeds.

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Necessarily, the speeds of approximately 2500-FPM for low carbon and 2,000 to 2200-FPM for high carbon, thus obtained, meant that better guarding of the Motoblox had to be provided for safety reasons. Finishing block guards and front safety guards were added. Figure 11.

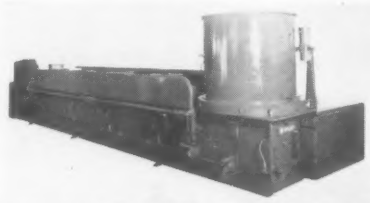

Fig. 11—5/6 HRD Motoblox. * * * * * * * *

With the higher drawing speeds, it was found that unstable wire drawing conditions were sometimes encountered—particularly on light loads at high speeds. To overcome this, booster generators for each spindle were introduced to supplement the main generator. However, while this arrangement provided definitely improved results, it was found to be too expensive.

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The development of our latest and most up-to-date Motoblox resulted from continued study and cooperation with an electrical manufacturer and a customer.

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It was found that there was enough space between the motors of the Motoblox to mount an individual small high speed motor generator set beside each motor. Without taking up much more room, the control for each motor could be mounted above the motor and thus, all the electrical equipment for the machine could be carried in a ventilated cabinet at the back of the machine. This resulted in a self-contained unit, mechanically and electrically, in practically the same over-all floor space originally required for just the machine.

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Inasmuch as the control is now almost completely wired at our factory, and our servicemen assist in the installation of the machine, the customer saves a considerable amount of electrical installation cost. Over-all floor space is greatly reduced because a separate room or additional space is not required for a large motor generator set, starter, and direct current control. Figures 12 and 13.

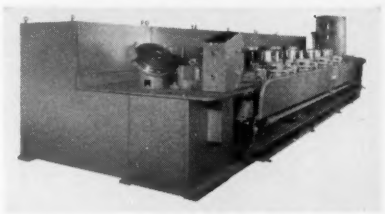

Fig. 12—6/7 HRD Motoblox. * * * * * * * *

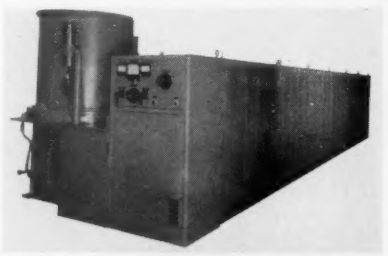

Fig. 13—6/7 HRD Motoblox. * * * * * * * *

The principal operating advantages of the electrical scheme are:

1. **Increased wire drawing speeds (especially true when spooling is used in conjunction with the machine).**
2. **Wider effective range of drawing speeds.**
3. **Greater flexibility as to die setups.**
4. **Increased stability at high drawing speeds and light loads.**
5. **Increased portability of machinery.**
6. **Simplification of electrical spare parts.**
7. **Generally greater continuity of operation.**

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Experimentally, speeds as high as 4,000-FPM on low carbon wire have been obtained on a 6/7-HRD Motoblox with this electrical scheme. Before such speeds become an operating practicality, much more work must be done on improving the taking up of the drawn wire. But inherently, the machine has built into it the speeds of tomorrow.

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Filling out the complete line of ferrous machinery are the wet drawing slip type HIC and HF cone

(*Please turn to page* 1266)

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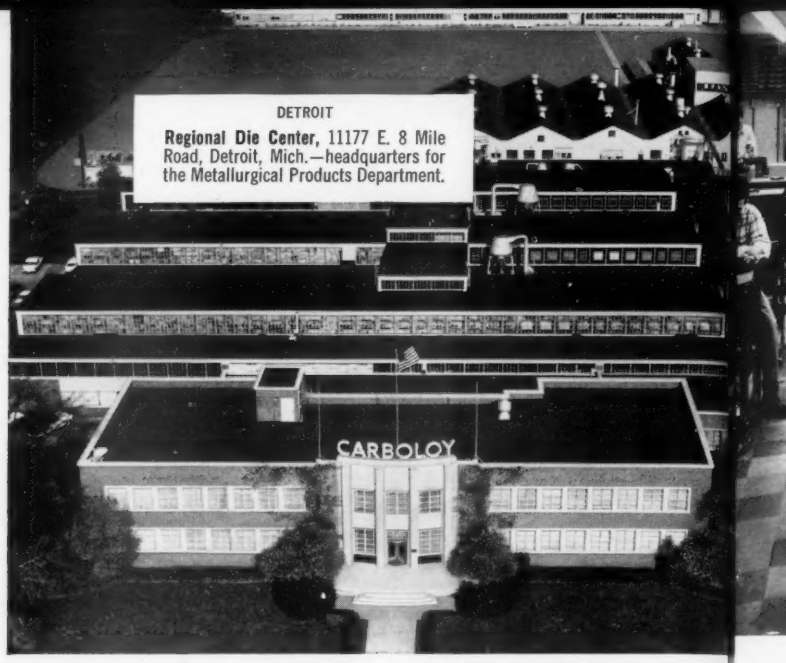

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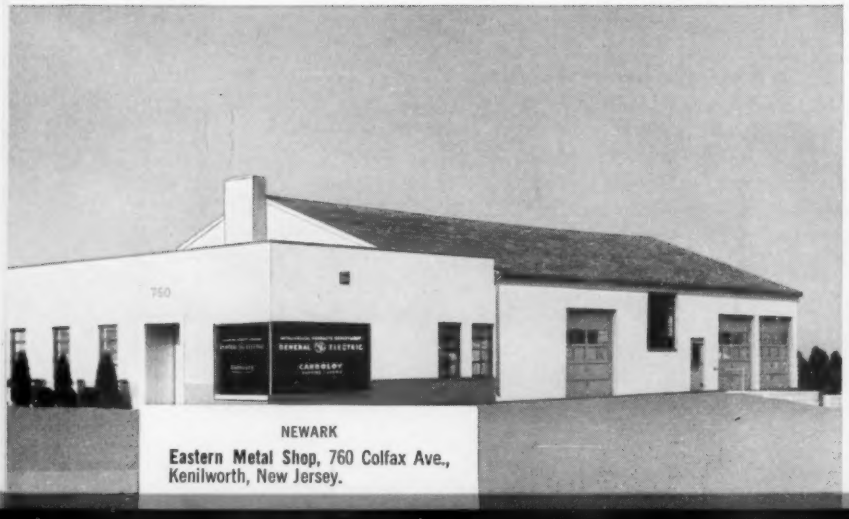

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Weaving of Aluminum Insect Screening

by Robert E. Hirt
Superintendent — Wire Mill
Hanover Wire Cloth Division
Continental Copper & Steel Industries, Inc.
Hanover, Pennsylvania

The report of the 1955 census of manufacturing, the most recent report available to me at the writing of this paper, shows that about 658,000,000 square feet of insect screening was produced that year. Of this, approximately 55% was Aluminum, and we have every reason to believe this figure will steadily increase in the next few years. This may seem like an amazing figure but what is even more amazing is the fact that approximately 60% of the total production of insect screening is manufactured in York County, Pennsylvania. There is a very logical explanation for this.

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The man who is considered the father of the modern insect screening industry, **William Kintzing,** was a native of Hanover, York County, Pennsylvania. Mr. Kintzing was employed by the York Wire Cloth Company in the early 1890's as a machinist to build and repair looms. After he had learned what there was to know about building looms, Mr. Kintzing began building his own wire cloth looms and promoting the organization of new companies in order to market his looms. Through his well designed looms and his promoting genius, Mr. Kintzing's efforts were rewarded by the organization of seven wire cloth companies in York County, alone. Most of these companies are still in operation and are considered giants in the screening industry. Kintzing sold looms in other localities in the United States as well as Germany, Canada, Australia and other countries. Many of these looms are still in operation, and the Kintzing design is still recognized as an extremely good one.

Robert E. Hirt

A paper prepared for presentation at the Annual Convention of The Wire Association at Chicago on October 16, 1957.

The author, a native Hanovarian, graduated from the Williamson Free School of Mechanical Trades in 1940. During the war he worked in Washington as a tool and instrument maker. He later became a field engineer for the Read-Standard Div. of Standard Stoker Company in York, after which he joined his present company.

During the 1920's, manufacturers began using Aluminum for insect screening, but originally the product was not a good one. The Aluminum wire used would not resist the elements well enough so as to give satisfactory durability. The Aluminum metallurgists went to work and came through with an Aluminum alloy clad material which they designated as 56S and which is now known as Alclad 5056 in the screening industry. In achieving the corrosive resistance necessary, the metallurgist used the relationship between electrode potentials and covered the Aluminum alloy core with a thin surface of Aluminum alloy which is resistant to corrosion and anodic to the core. In this manner the core is protected physically by the surface layer of cladding and electrolytically at areas where the core

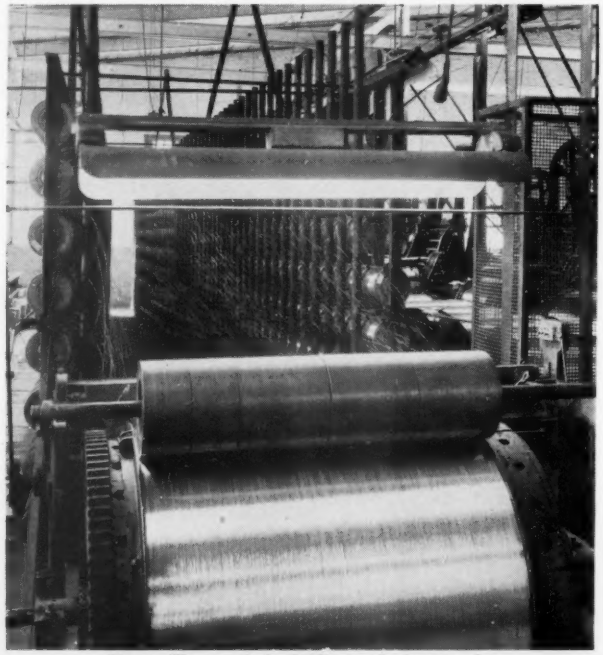

Fig. 1—Warp rack for holding reel of warp wire.

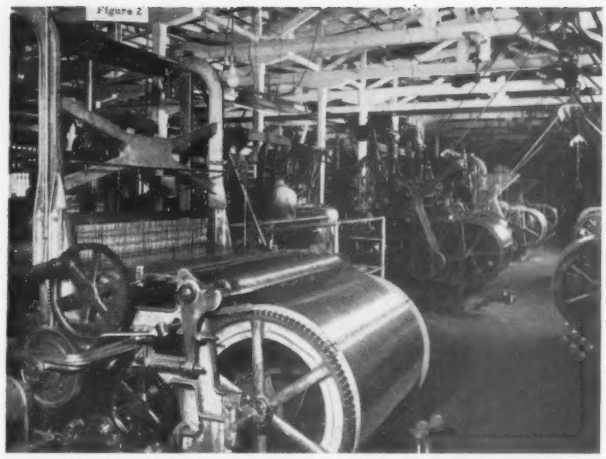

Fig. 2—Warp rack in place at the weaving loom. * * * * * *

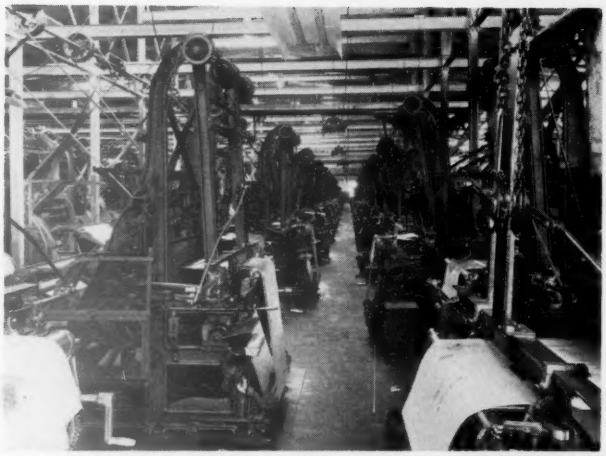

Fig. 3—Arrangement of looms in double rows. * * * * * * *

may have been exposed by scratching or other abrasive action.

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The weaving of good Aluminum cloth can be accomplished only if the wire used is of the highest possible standards. High quality weaving wire has its beginning in the furnaces and rolling mills where its character is formed, on through to the rod mills, annealing, fine wire drawing and normalizing, where its personality is developed.

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Aluminum insect screen cloth is woven with .013 diameter wire, which to give required results, should be within the tolerance of plus .0002, and minus .0001, and not more than .00015 out of round. The wire at the .013 size should have a tensile strength of approximately 7½ pounds. A variation of a half pound either way will not usually cause too much concern, except occasionally "sleezy," lifeless cloth can be attributed to too much variation in the tensile strength of the wires on the warp.

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Before World War II the standard mesh for insect screen cloth was 16 x 16. This means that there were 16 wires to the inch in both directions, producing a square mesh. During the war in order to increase production, the Government ordered industry to change over to 18 x 14 mesh. This meant that there were 18 wires per inch on the warp, or length of the roll of cloth, and only 14 wires per inch on the cross wires, which increased production about 13%. This mesh is now the standard, and is being produced for maximum insect protection at lower cost per unit.

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The warp, which is the accepted term for the drum on which the wire is wound to produce the length of the cloth, is wound from an apparatus called the warp rack. Figure 1 shows a warp in the foreground being wound from a warp rack in the background. The warp rack is nothing more than a mechanism used for holding the spools while the wire is being wound on the warp. The warp rack shown in this figure has a capacity of 864 spools. If it is necessary to wind a warp requiring more wires than the capacity of the warp rack, the warp is wound in sections. After the warp is wound, it is removed from the warp rack and attached to the loom as shown in Figure 2. Each wire is then passed individually, by hand, through the reed and attached to a roll at the front of the loom. The cross wire, or bobbin wire, is passed from side to side by a shuttle bar, and is crimped at each cross-over by the alternating action of the reed, which raises and lowers every other wire on the warp after each pass of the shuttle bar. Throughout this entire operation, extreme care must be taken so as not to damage the wire in any way. Although Aluminum screening has exceptional durability and considerable strength when woven, it will scratch and bend very easily during the single strand stage and many causes of rejected cloth have been attributed to scratched or otherwise damaged wire.

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As mentioned earlier in this paper, annealing and drawing practices are vitally important in Aluminum weaving wire. Spaces wider than the 1/14 of an inch on the cross wire, called "flybacks" in some plants, can, in many instances, be traced to poor annealing practices at the rod break down sizes, or in the normalizing operation after fine wire drawing. The wire is harder than desired and resists crimping. This is generally a cause for rough or "washboard" wire, as well.

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Concerning wire drawing practice, wire that is round, but varying too much in size, can cause an uneven appearance if a group of exceptionally large wires is woven with wires exceptionally small. Hence, the need for close tolerance on the wire size. Wires that are out of round beyond the permitted tolerance are referred to in the loom room as "flat" wire and can cause much concern if they slip through inspection. These wires tend to turn and lay in the cloth with the "flat" sides on the surface

(*Please turn to page* 1281)

Furnaces for the Heat Treatment of Wire

by John P. Zur, Chief Engineer, Non-Ferrous and Wire
Industrial Furnace Division
Sunbeam Corporation
Chicago, Illinois

The heat treatment of round, flat, and shaped wire, includes many metallurgical operations, and covers an extremely wide range of precessing temperatures. In the non-ferrous applications, we have sub-critical and full annealing operations on copper, brass, bronze, and aluminum wires. On mild and high carbon steel, alloy, and stainless grades, we must consider various annealing treatments, stress relieving, spheroidizing, normalizing, patenting, oil tempering, carbon restoration, etc. The heat treatment of wire in coils is often problematic in that conditions of uniform heating throughout the section of the coil can be difficult to attain. Heat treatment of strands in continuous operation also requires the utmost care to maintain uniform and exacting time and temperature conditions.

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The manufacture of electrical conductors, spring, rope, and music wire, prestressed concrete wire, welding wire, and a host of other types, and grades of wire too numerous to mention, involves adherence to increasingly rigid specifications and requirements. Heat treatment plays an important part in wire processing, and much depends upon the application of proper, uniform, efficient, and economical heat treating practice.

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In view of the fact that this subject covers an extremely broad range of furnace types and practices, the scope of this paper is necessarily limited. An attempt will be made to outline the general types of furnace equipments in use, their applications, with a brief summary of the trend of furnace designs for the heat treatment of wire.

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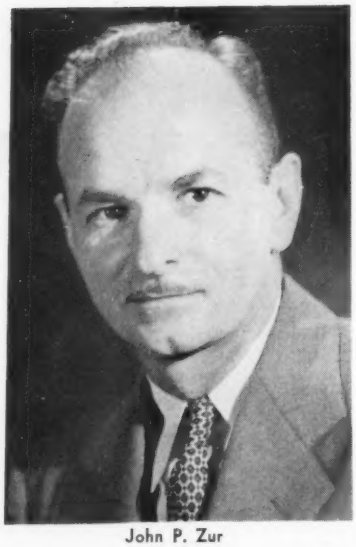
Heat treatments for wire may be classified into two general categories, namely, finishing treatments, and intermediate heat treatments. In the case of finishing treatments such as oil tempering, and certain forms of annealing, the material is ready for shipment to the ultimate user. The intermediate heat treatments which include annealing, spheroidizing, patenting, etc., are for purposes of preparing the structure of the wire for subsequent drafting, rolling, forming and other processing operations.



John P. Zur

A paper prepared for presentation at the Annual Convention of The Wire Association at Chicago on October 15, 1957. The author received a degree of Metallurgical Engineer in 1934. He was Chief Engineer of the Trauwood Engineering Company from 1938 to 1951, Production Manager of Lee Wilson Contracting Company from 1951 to 1953, Vice President of The Trauwood Engineering Company from 1953 to 1956, and in 1956 joined Sunbeam in his present capacity.

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Furnaces for the heat treatment of wire fall into three general types:

1. **Batch furnaces, where the coils of wire are loaded or charged into the furnace in units or multiple units, put through the required heating and possibly cooling cycle and removed when the cycle is completed.**
2. **Continuous furnaces involving the loading of individual coils on a conveying mechanism, such as a belt, chain, pusher, roller hearth, etc., which carries or moves the coils through the necessary heating and cooling zones.**
3. **Strand furnaces, where the coils are loaded on vertical pin pay-off reels or swifts, from which the wire is unwound and mechanically pulled through definite heating, quenching, and cooling cycles, and continuously rewound on takeup reels or spools.**

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The particular heat treatment required predicates the type of furnace equipment used. Batch operations are particularly suited to heat treatments such as spheroidizing and annealing where the time temperature cycles involved are appreciably long and could not be adapted to continuous or strand heat treatment. Continuous furnaces for coils are applicable in many forms of annealing treatments on non-ferrous wire, and annealing and carbon restoration on ferrous wire, and are of particular interest where large tonnage production is involved. Certain operations like patenting, oil tempering, and some types of annealing must be done in strands. Batch or continuous coil heat treatment has not proved adaptable to these operations, in view of the extremely critical heating and quenching conditions required.

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Perhaps one of the best examples of good batch annnealing practice is the bell type annealing furnace. Figures 1 and 2 illustrate a typical cover or bell type furnace installation for annealing wire in coils. These furnaces are either electrically heated, direct fuel fired, or radiant tube heated, and are particularly adaptable to the annealing of ferrous and nonferrous wires, and the spheroidizing of carbon steel wire. The

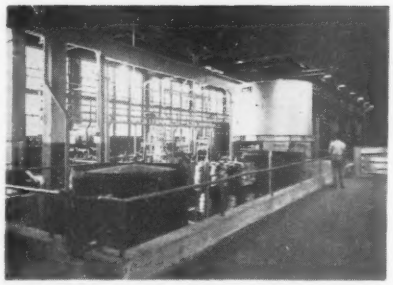

Fig. 1—Bell type furnace for copper wire annealing.

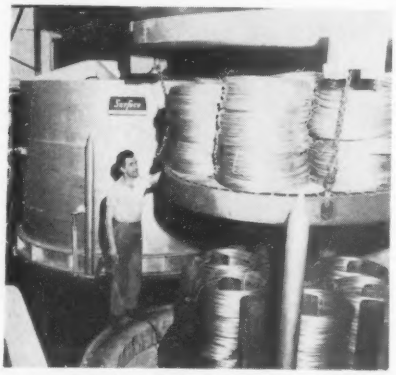

Fig. 2—Bell type furnace for copper wire annealing.

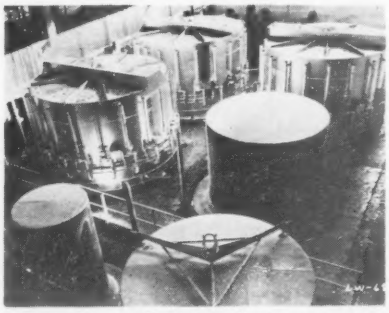

Fig. 3—Large radiant tube heated, cover type annealing furnaces.

furnace shell is removed by crane, and set on another loaded base while the finished charge is being removed. Figure 3 shows a group of radiant tube heated, high convection bell type furnaces. The general arrangement consists of a heating cover, an alloy inner cover, and a base. As a rule, several bases are used with each heating cover, which arrangement works into required production schedules very well. Figure 4 is a sectional view of one of these furnaces showing the heating cover with radiant tubes, the base on which are mounted the fan, the diffuser assembly, and the inner cover. The wire is loaded on stems or spiders in either a single or multiple stack arrangement. Water, oil, and sometimes sand seals are provided

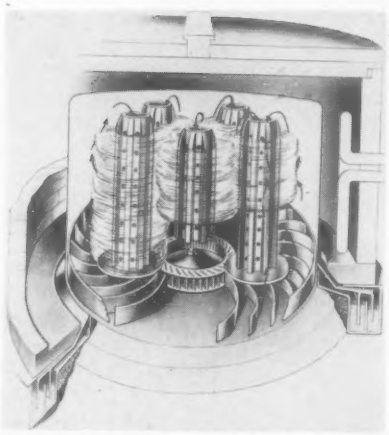

Fig. 4—Sectional view of radiant tube, cover type annealing furnace for wire in coils.

for the inner cover, making the heating chamber gas tight, and ideally suited to annealing operations with prepared atmospheres. Extremely high forced convection recirculating rates are used to insure uniform temperature conditions throughout the load. Figure 5 shows a closeup of a base with three stems of wire, ready to receive the inner cover and heating cover.

Fig. 5—Cover type furnace showing base with stems of wire loaded.

Salt baths, either externally fuel fired, immersion tube heated or electrically heated by means of internal electrodes are also commonly used for the annealing and spheroidizing of wire. Figure 6 illustrates a typical internally heated salt bath installation for rod and wire. Note the low voltage transformer equipment on the left. Furnaces of this type use a fused salt of carbonates, chlorides, or nitrates. Low voltage electrical

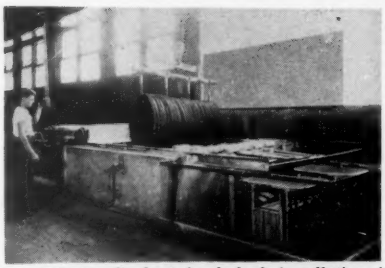

Fig. 6—Internally heated salt bath installation.

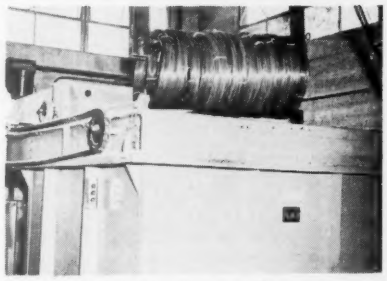

Fig. 7—Salt bath for wire annealing.

current is passed directly through the salt by means of the submerged electrodes which provides the heating effect. Figure 7 shows another submerged electrode salt bath installation. The rolling cover seen at the right is provided for purposes of reducing heat loss from the surface of the salt by radiation. Salt baths can be used over an extremely wide temperature range and make it possible to heat very rapidly and uniformily without oxidation.

Fig. 8—Fuel fired annealing furnace for stainless steel wire.

Figure 8 illustrates a fuel fired batch type furnace installation for the annealing of stainless steel wire in coils. Note the water quench in the foreground. Coils are handled in and out of the furnace and quenched by means of an overhead fork arrangement. This type of furnace is particularly adaptable to small lot batch operation for intermediate annealing of stainless steel wire between

cold drawing operations. Various methods of handling are utilized in this type of in and out furnace.

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A large fuel fired continuous pusher type furnace for the annealing of wire in coils is shown in Figure 9. This furnace is adapt-

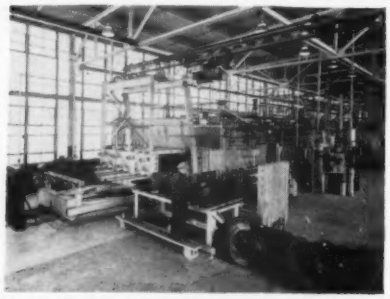

Fig. 9—Pusher coil cycle annealer. * * * *

able to many cycle annealing operations involving controlled cooling and also to carbon restoration treatment. The furnace is heated by means of suction type, radiant tubes arranged in six zones of control. Figure 10 shows another view of this furnace. A vestibule is provided at the charge end and discharge end to provide means of purging and satisfactory operation

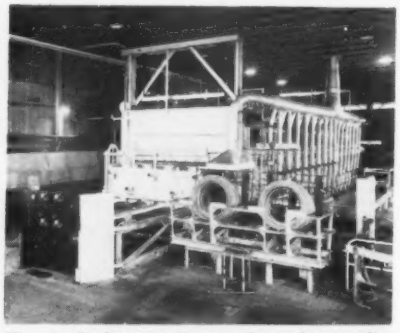

Fig. 10—Pusher type furnace for cycle annealing or carbon restoration. * * * * * * * * *

with prepared atmospheres. Furnaces of this type operate on an automatic cycle, which can be varied over a comparatively wide range. The coils of wire are loaded into the vestibule and the operator pushes the cycle push button. From this point on, the cycle is completely automatic until the coils are discharged at the other end of the furnace.

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It is often of advantage to use strand equipment for the annealing of high and low carbon, alloy, and stainless steel wire and strip, particularly where other processing and coating operations are carried on "in line" with annealing. Fuel fired, radiant tube heated, and electric furnaces, lead baths and salt baths are commonly used in strand practices.

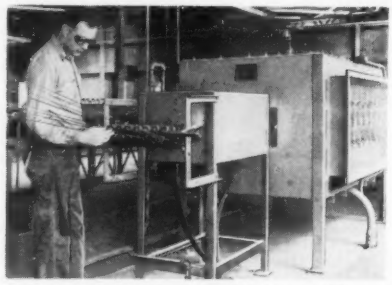

Fig. 11—Tube furnace for bright annealing. *

Figure 11 is a typical discharge end view of a small tube furnace for the annealing of stainless steel wire in strands. This furnace is heated by nonmetallic electrical resistors mounted horizontally in the heating chamber. Each strand of wire travels through an individual alloy tube. The annealing treatment incorporates a cooling chamber, with water circulating around the tubes. A similar furnace is illustrated in Figure 12. Note the

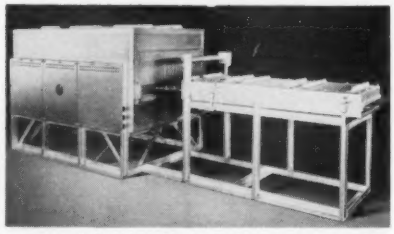

Fig. 12—Globar heated tube furnace. * * * *

atmosphere gas manifold and tube connections between the heating and cooling chambers. In the annealing of stainless steel wire, dry hydrogen and disassociated ammonia atmospheres are used. Where the wire is to be redrawn, a slightly oxidizing atmosphere (1% - 3%) produces an oxide which is readily pickled off. Tube furnaces utilize various heating means, metallic resistors, nonmetallic resistors, and fuel combustion. In many applications, the heating is designed for two, three, or more zones of control, depending on the length of the furnace.

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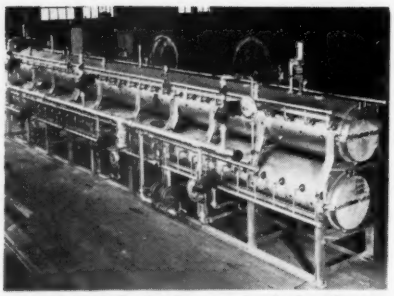

Fig. 13—Fuel fired tube type hardening furnace.

A unique tube furnace is shown in Figure 13. This cylindrical design makes use of two separate gas fired heating chambers, mounted one above the other, each with three zone heat control. This particular furnace is used for hardening narrow strip and utilizes quench die blocks at the discharge end. The draw furnace used in conjunction with this hardening furnace is shown in Figure 14. These furnaces effect a considerable saving in floor space, and are ideally suited to many strand heating applications. Long furnaces of this type are usually equipped with removable roofs for easy access to the interior for maintenance purposes.

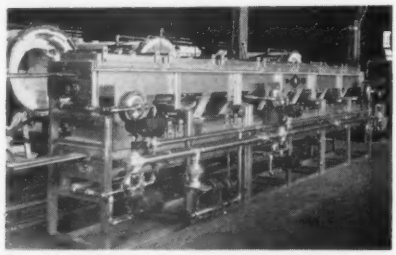

Fig. 14—Fuel fired tube type draw furnace. * *

Flat wire and strip is often annealed in vertical tower furnaces similar to that illustrated in Figure 15. This shows the discharge end of the installation, with the expanding arbor type of takeups in the foreground. Multiple passes through the heating and cooling chambers are easily incorporated, with considerable savings in floor space. Radiant heating with electrical resistors, radiant tubes, and cup type burners is common practice. Cooling chambers are usually water jacketed, with supplementary forced convection recirculation where required.

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Patenting is perhaps one of the

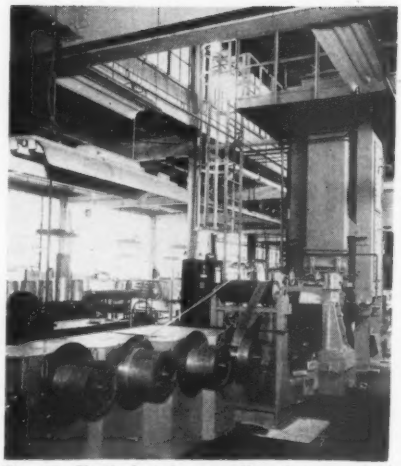

Fig. 15—Vertical strip annealing furnace. * *

most important heat treating operations in the wire mill. Practically all medium and high carbon steel wire or rod is patented at least once, and possibly two or three times in the course of being drawn to finish wire sizes. Patenting practices vary over an extremely wide range on the different types and grades of wire. The production of spring, rope, and music wire, and prestressed concrete wire requires the application of specific practices to attain the desired physical properties in the finished drawn wire. In general, the objects of the patenting operation are to produce a metallurgical structure best suited to the subsequent operation of cold drawing, and one which will give the optimum physical properties in the drawn wire. It involves heating the strands to a solution temperature, and quenching to a temperature to induce the fine pearlitic structure desired. Practically all patenting is done in multiple strand operation, utilizing furnaces or lead baths for heating, and air, lead, or salt baths maintained at a constant, controlled temperature for quenching.

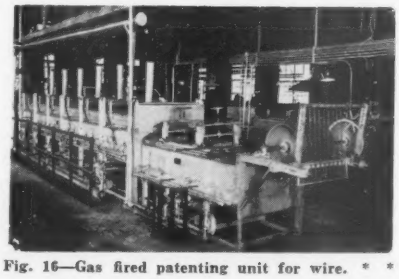

Fig. 16—Gas fired patenting unit for wire. * *

Figure 16 shows a typical gas fired furnace patenting installation with an underfired lead quench. Both the heating furnace and quench bath make use of multiple zone control.

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The discharge end of a large overfired patenting furnace with multizone control is shown in Figure 17. The wire entrance end of

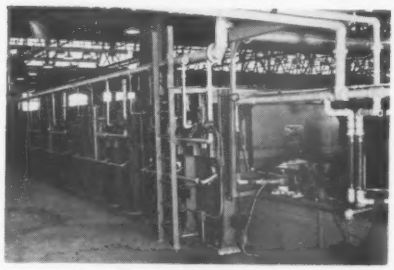

Fig. 17—Continuous wire patenting discharge end of furnace. * * * * * * * * * * * * *

the lead quench bath is shown in the foreground. In many applications, continuous pickling, rinsing, and coating operations are incorporated into the patenting line, so that the wire is ready for further drafting when it reaches the take-up blocks. In some instances, hot dip or electro-galvanizing is done in line with patenting.

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Another view of this patenting installation is shown in Figure 18.

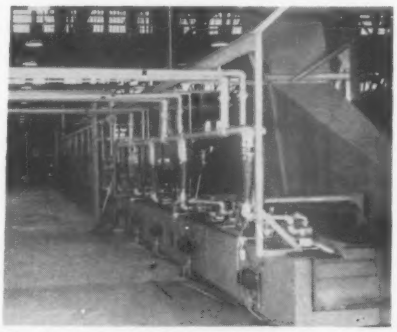

Fig. 18—Continuous wire patenting. Lead quench in foreground. * * * * * * * * * * * * *

Note the gas fired immersion heating units in the lead quench bath, arranged for zone control. This type of heating unit gives fast response, which results in very close temperature control of the quench bath.

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Figure 19 illustrates a large 60 foot radiant tube fired patenting furnace. Furnaces of this type op-

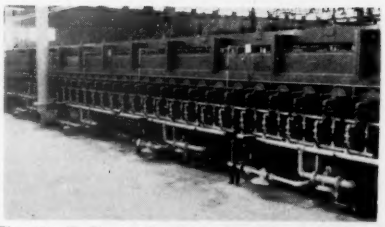

Fig. 19—Radiant tube fired patenting furnace. *

erate at a comparatively high thermal head, making it possible to patent at high speeds. The silicon carbide radiant tubes are mounted in a horizontal position in the furnace chamber, over the wire. The arch is made in sections with lifting rings and a sand seal where the sections join the furnace proper, so that the sections can be easily removed for access to the furnace interior. This furnace makes use of several zones of control.

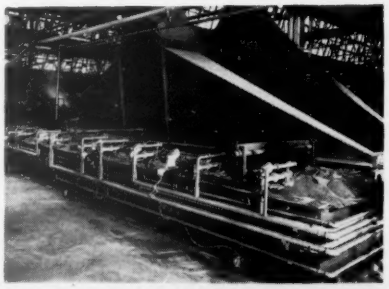

Fig. 20—Three-zone lead quench on patenting line. * * * * * * * * * * * * * * * * *

A large patenting lead quench with gas fired immersion heating units is shown in Figure 20. Note the three zones of temperature control. This is particularly important in long patenting quench baths. The carbonaceous covering (coke breeze), and the sand drag wipe at the discharge end of the bath are typical of lead bath installations.

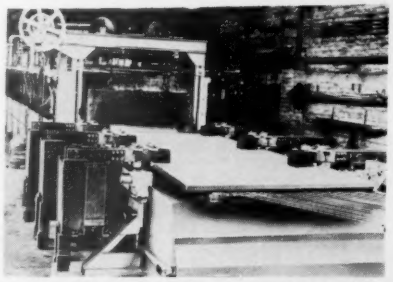

Fig. 21—Internally heated salt quench bath on wire patenting line. * * * * * * * * * *

An electric, internally heated, electrode type of salt quench bath

(*Please turn to page* 1275)

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The Wire Association is a non-profit organization of wire mill executives, superintendents and foremen. It also includes plant engineers, traffic men, and all others engaged in the production of cold drawn bars, rods, wire, strip, insulated wire and cable, and the manufacture and fabrication of finished wire products, including cold headed, extruded and other cold worked metal products.

There are separate divisions for all the various major interests in the wire industry, steel, iron, brass, copper, alloy, and precious metals, together with divisions relating to drawing, cold working, cold heading, extruding, fabricating, forming, spring making, wire cloth, wire rope, bare and covered electric wire and cable and all other forms of wire and wire products.

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The Association functions along the following lines:

1. The use of the Association headquarters as a central clearing house for information and data of all kinds which may be of interest to members.
2. The exchange of ideas on processes of production including machinery, technical processes, etc.
3. The establishment and maintenance of friendly relations among the members of the association and the development of sectional and national meetings to discuss matters of mutual interest.
4. Studies of production methods and analysis of production costs.
5. Developments in the use of new materials and new applications of existing materials and by-products.
6. Research and collection of information on personnel management, including such factors as labor turnover, seasonal changes in the demand for employees, wage scales, etc.
7. Standardization and simplification as a means for the effective elimination of waste.
8. Such other subjects as may be determined upon.

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LA SALLE HOTEL, CHICAGO, ILLINOIS, MONDAY THROUGH THURSDAY OCTOBER 14-17, 1957

The Wire Association's Headquarters at The La Salle Hotel
Will be open each evening from Sunday, October 13th, except Wednesday night.
YOU ARE CORDIALLY INVITED TO CALL AND MEET OTHER WIRE INDUSTRY MEN

THERE WILL BE A REGISTRATION FEE OF $11.00 FOR MEMBERS AND $13.00 FOR NON-MEMBERS, INCLUDING AN ANNUAL LUNCHEON TICKET, FOR ALL THOSE ATTENDING THE TECHNICAL SESSIONS AND MEETINGS. PLEASE HAVE YOUR ASSOCIATION MEMBERSHIP CARD WITH YOU AND SHOW IT WHEN REGISTERING.

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William H. Louder, Supt., Wire Mills
Bethlehem Steel Corp.
Williamsport, Pa.

Gordon T. Spare, Research Project Eng.
American Steel & Wire Div.
United States Steel Corp.
Cleveland, Ohio

Technical papers are preprinted in the October issue of Wire and Wire Products insofar as possible. Titles to papers accepted will be given to The Wire Association and duly copyrighted at the time of publication.

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Kaiser Aluminum and Chemical Corp.,
Newark, Ohio

Alexander A. Kerr, Supt. Prod.,
Electrical Wire Div.
John A. Roebling's Sons Corp.
Trenton, N. J.

J. F. Stoltz, Eng., Rod and Wire Mfr.
Hawthorne Works, Western Electric Co.
Chicago, Ill.

All wire mill men and wire mill suppliers are invited to attend this convention, see how the Association functions and participate in the activities. Simultaneous technical sessions for Ferrous and Non-Ferrous Divisions are held.

REGISTRATION AND TECHNICAL MEETING ROOMS ARE ON THE MEZZANINE. Please be prompt in your arrival for the technical sessions. Those with rooms for entertainment are requested NOT TO KEEP THEM OPEN during the technical sessions.

MONDAY, OCTOBER 14th

9:00 A.M.
REGISTRATION

10:00 A.M.
DIRECTORS' MEETING

12:30 P.M.
PROGRAM COMMITTEE LUNCHEON

THE CONVENTION PROGRAM

LA SALLE HOTEL, CHICAGO, ILLINOIS, OCTOBER 14-17, 1957

MONDAY MORNING—

9:00 A.M. Registration Desk opens on the Mezzanine Floor.

10:00 A.M. Annual Meeting of the Board of Directors of The Wire Association.

12:30 P.M. Directors' Luncheon for Program Participants. Address of Welcome by Tom M. Girdler, Jr., President, The Wire Association.

FERROUS DIVISION TECHNICAL SESSIONS

MONDAY AFTERNOON—2:00 P. M.

CHAIRMAN OF MEETING

John M. Corson, Manager of The Laboratory
The Carpenter Steel Co., Reading, Pa.

SYMPOSIUM ON PLATING WIRE FOR EYE APPEAL

PAPER: "Survey of Finishes and Processes"	by R. T. Gore, Market Development Eng. Metal and Thermit Corp., Rahway, N. J.
PAPER: "Plating Wire for Eye Appeal"	by O. B. Lusk, Chief Inspector, United Steel & Wire Co., Battle Creek, Mich.
PAPER: "Plating Wire from the Consumers' Standpoint"	by L. L. Johnson, Engineering Specialist Philco Corporation, Philadelphia, Pa.
PAPER: "Progress in Vertical Storage"	by A. F. Anjeskey, Sales Mgr., Cleveland Tramrail Div. Cleveland Crane & Engineering Co. Wickliffe, Ohio

TUESDAY MORNING—9:30 A.M.

CHAIRMAN OF MEETING

William R. Cook, Assistant Superintendent, Wire Mill
Union Wire Rope Corp., Kansas City, Mo.

PAPER: "Combined Hot Rolling and Patenting of Rod"	by Dartrey Lewis, Chief Eng., Res. & Devel. John A. Roebling's Sons Corp., Trenton, N. J.
PAPER: "A Simplified System for Carbon Restoration"	by John Arnold, Chief Engineer Lee Wilson Engineering Co., Inc., Cleveland, Ohio
PAPER: "Comparison of Gas and Electric Strand Annealing Furnaces"	by Harold Notarius, Mechanical Engineer Wilbur B. Driver Co., Newark, N. J.
PAPER: "Furnaces for the Heat Treatment of Wire"	by John P. Zur, Engineer-Non-Ferrous & Wire Industrial Furnace Div., Sunbeam Corp., Chicago, Ill.
PAPER: "Continuous Electric Direct Resistance Method for Heat Treating of Steel Wire"	by Oscar C. Trautman, President The Trauwood Engineering Co., Cleveland, Ohio

TUESDAY AFTERNOON—2:00 P.M.

CHAIRMAN OF MEETING

Gordon T. Spare, Project Engineer, American Steel & Wire Div.
United States Steel Corp., Cleveland, Ohio

PAPER: "The History of and New Developments in Wire Packaging"	by Fred J. Bieber, President Acrometal Products, Inc., Minneapolis, Minn.
PAPER: "Wire Packaging System"	by E. Jefferson Crum Riderwood, Md.
PAPER: "Recent Developments in Steel Wire Drawing Machinery"	by James E. Spearman, Asst. to the President and Maurice A. Nye, Chief Eng. The Vaughn Machinery Co., Cuyahoga Falls, Ohio
PAPER: "A Weldable, Hardenable 12% Chromium Alloy"	by W. R. Kegerise, Metallurgist-Development The Carpenter Steel Co., Reading, Pa.

WEDNESDAY MORNING—9:30 A.M.

CHAIRMAN OF MEETING

Carleton W. Garrett, Metallurgical Eng., Product Development Div.
Jones & Laughlin Steel Corp., Aliquippa, Pa.

PAPER: "Appropriate Rods for Appropriate Wire"	by Ivan P. De Witte, C.E., Mgr. of Res. & Control Trefileries Leon Bekaert, Zwevegem, Belgium
PAPER: "Mechanical Blast Cleaning of Wire Rod"	by Kenneth J. Sorace, Chief Project Eng. Lamson & Sessions Co., Cleveland, Ohio and Gilbert D. Dill, Eng., Chg. Steel Div. Wheelabrator Corp., Mishawaka, Ind.
PAPER: "Stainless Steel Cold Heading Wire"	by S. E. Tyson, Metallurgist-Stainless Steels The Carpenter Steel Co., Reading, Pa.
MOTION PICTURE: "The Long Pull"	Shown through the courtesy of the Bethlehem Steel Company, Bethlehem, Pa.

THE CONVENTION PROGRAM

LA SALLE HOTEL, CHICAGO, ILL., OCTOBER 14-17, 1957

NON-FERROUS DIVISION TECHNICAL SESSIONS

MONDAY AFTERNOON—2:00 P. M.

CHAIRMAN OF MEETING

Richard E. Hutchinson, Assistant Production Superintendent,
Kaiser Aluminum & Chemical Corp., Newark, Ohio.

PAPER: "Production Control—Functions and Organization" — by James D. Donovan, Asst. Production Superintendent, Kaiser Aluminum & Chemical Corp., Newark, Ohio.

PAPER: "Aluminum for Fastener Production" — by O. L. Burtenshaw, Senior Metallurgist, Kaiser Aluminum & Chemical Corp., Newark, Ohio.

PAPER: "Oxide Coatings on Aluminum Wire" — by A. A. Defoe, Chief Engineer, Electrical Conductor Engineering Dept., Aluminium Laboratories Limited, Kingston, Ont., Canada

TUESDAY MORNING—9:30 A. M.

CHAIRMAN OF MEETING

J. F. Stoltz, Engineer, Rod and Wire Manufacture, Western Electric Co., Chicago, Ill.

PAPER: "Continuous Vulcanization of Butyl Insulated High Voltage Cable" — by A. L. Rosener, Jr., Process Development Engineer, John A. Roebling's Sons Corp., Trenton, New Jersey.

PAPER: "A Practical Approach to the Extrusion of Thermoplastics" — by Donald C. Craft, Sales Service Lab., Polychemicals Dept. E. I. du Pont de Nemours & Co., Wilmington, Delaware.

PAPER: "A Method of Controlling the Contour of Tungsten Carbide Dies Used in Drawing Copper Wire" — by W. R. Moyers, Chief, Wire Engineering Dept. and G. M. McLeod, Prod. Eng., Wire Drawing and Enameling Dies, Western Electric Company, Inc., Tonawanda Plant, Buffalo, New York.

TUESDAY AFTERNOON—2:00 P. M.

CHAIRMAN OF MEETING

Alexander A. Kerr, Superintendent of Production,
John A. Roebling's Sons Corporation, Trenton, New Jersey.

PAPER: "Weighing Samples of Wire to Determine Accurately the Hole Size of Fine Gage Diamond Dies" — by W. R. Moyers, Chief, Wire Engineering Dept. and G. M. McLeod, Prod. Eng., Wire Drawing and Enameling Dies, Western Electric Company, Inc., Tonawanda Plant, Buffalo, New York.

PAPER: "Standardization of Torque Values for Stiffness Testing of Wires Used as Radio Grid Siderods" — by J. R. Howell, Engineer in Charge, Engineering Services, Sylvania Electric Products Inc., Warren, Pennsylvania.

PAPER: "Buried Distribution of Telephone Circuits" — by C. C. Lawson, Plant Facilities Eng., Bell Telephone Laboratories, Inc., Murray Hill, New Jersey.

WEDNESDAY MORNING—9:30 A. M.

CHAIRMAN OF MEETING

Samuel C. Avallone, Division Metallurgist, Electric Cable Works, American Steel & Wire Div.,
U. S. Steel Corporation, Worcester, Mass.

PAPER: "Weaving of Aluminum Insect Screening" — by Robert E. Hirt, Supt. Wire Mill, Hanover Wire Cloth Div., Continental Copper & Steel Industries, Inc., Hanover, Pa.

PAPER: "The All-Metal Reel—for Modern Cable Packaging" — by George L. McCandless, Vice President, George Evans Corp., Chicago, Ill.

FILM: "Cable Makers" — Shown through the courtesy of Rome Cable Corp., Rome, New York

WEDNESDAY PROGRAM (Cont'd.)

AT 1:00 P.M.—THE ANNUAL WIRE ASSOCIATION LUNCHEON

(Century Room, 19th Floor)

LADIES ARE WELCOME LADIES ARE WELCOME

THE PRESENTATION OF AWARDS FOR 1956 PAPERS

MEDAL AWARD (FERROUS DIV.): To George A. Sweitzer, Jr., Metallurgical Investigator, Jones & Laughlin Steel Corp., Aliquippa, Pa., for his paper: "Electromatic Oil Tempered Wire."

MEDAL AWARD (NON-FERROUS DIV.): To John D. Sprowl, Department of Metallurgical Research, Kaiser Aluminum & Chemical Corp., Spokane, Wash., for his paper: "Hot Dip Wire Aluminizing Processes and Alloys."

CERTIFICATE OF HONORABLE MENTION (FERROUS DIV.): To N. Dale Montgomery, Metallurgist, Rod and Wire Div., Pittsburgh Steel Company, Monessen, Pa., for his paper: "Control Measures for the Heat Treatment of High Carbon Rods and Wire."

CERTIFICATE OF HONORABLE MENTION (NON-FERROUS DIV.): To Benjamin H. Davis, Vice President, The Davis-Standard Div., Franklin Research Corp., Mystic, Conn., for his article: "Temperature Control for Thermoplastic Extruders."

PRESENTATION OF TWENTY-FIVE YEAR CERTIFICATES by Leslie C. Whitney, Chairman, Board of Past Presidents.

THE MORDICA MEMORIAL LECTURE: "About The Wire Association" by Richard E. Brown, Executive Secretary, The Wire Association, Stamford, Conn.

AT 4:00 P.M.—THE ANNUAL MEETING OF THE WIRE ASSOCIATION

This is the annual business meeting of members of the Association. Your personal attendance is needed and urged to discuss proposals and transact business.

Chairman of Meeting
Tom M. Girdler, Jr., President
The Wire Association

IN THE EVENING BALLROOM, 19TH FLOOR

THE ANNUAL STAG SMOKER--DINNER

6:30 P.M.—Cocktail Bar Opens

7:30 P.M.—Dinner and Show

CHAIRMAN, ENTERTAINMENT COMMITTEE: Eber J. Hubbard, Jr.

COME ONE, COME ALL—ENJOY FELLOWSHIP AND A GOOD SHOW!

THURSDAY MORNING

PLANT INSPECTION TRIPS

FERROUS DIVISION TOUR—Busses will leave the hotel at 9:00 for the tour of the Joliet Works of the American Steel and Wire Division of the U. S. Steel Corp. at Joliet, Ill. Luncheon will be served there through the courtesy of the division.

NON-FERROUS DIVISION TOUR—Busses will leave the hotel at 9:30 for the tour of Revere Copper & Brass mill.

ALL MEN IN ATTENDANCE ARE INVITED TO GO ON ONE OR THE OTHER OF THESE TOURS. BE SURE TO BUY YOUR BUS TICKET IN ADVANCE.

FOR THESE TOURS, ALL PERSONS MUST GO BY BUS. NO PRIVATE CARS MAY BE USED. TO BE ADMITTED, EACH VISITOR MUST WEAR HIS BADGE; NO EXCEPTIONS PLEASE. THESE MEASURES ARE FOR SECURITY, SAFETY AND THE IDENTIFICATION OF VISITORS.

These plant inspection trips conclude the 1957 Convention.

RESEARCH PAPERS ARE PREPRINTED IN THE OCTOBER ISSSUE OF WIRE AND WIRE PRODUCTS.

A summary of the discussions and the Mordica Memorial Lecture will appear in the January issue of Wire and Wire Products.

Papers not received in time for preprinting will be published in the November and December issues of Wire and Wire Products.

THE MORDICA MEMORIAL LECTURE

An invitation to deliver the Mordica Memorial Lecture is considered the highest honor within the power of the Board of Directors of The Wire Association to bestow upon a member.

The lecturer is selected each year by the Board of Past Presidents on the basis of outstanding contributions to the wire industry.

The 1957 Lecture will be delivered by Major Richard E. Brown, Publisher of WIRE AND WIRE PRODUCTS and Executive Secretary of THE WIRE ASSOCIATION. The subject will be "ABOUT THE WIRE ASSOCIATION" and the lecture will relate to the organization and development of the Association.

THE ANNUAL MEDAL AWARDS

Every year a bronze Medal is presented to an author in each of the Association's divisions—Ferrous and Non-Ferrous—for those papers that come nearest to the requirements set forth herein. Honorable mention Certificates are also awarded. These awards are presented during the Annual Convention of The Wire Association.

★ ★ ★

Consideration for such awards is not limited to papers presented at Association meetings, but to all papers submitted by members as a contribution to The Wire Association and published in WIRE AND WIRE PRODUCTS.

★ ★ ★

All papers submitted become the property of The Wire Association and are assigned to WIRE AND WIRE PRODUCTS for copyrighting and exclusive publication.

★ ★ ★

Awards, you will note, are a recognition of a definite contribution to the advancement of the interests of the Wire Industry.

★ ★ ★

Selection of papers for awards rests in the hands of the Association's Committee on Awards, which is headed by a director of The Wire Association.

REQUIREMENTS FOR CONSIDERATION OF PAPERS

The first consideration of eligibility is that the author or authors must be Association members. A second is that it must be a contribution to the Association or to WIRE AND WIRE PRODUCTS, as articles for which the magazine has paid an honorarium cannot be considered. A third is that any paper that has been previously presented before another society or published in another magazine cannot be taken under advisement for awards.

★ ★ ★

JUDGING PAPERS

Papers eligible for awards are judged by the Oxford System, which is considered the best one so far devised for the impersonal determination of the worthwhileness of papers. Consideration is given to the following points, among others:

1. Value of the paper to The Wire Association's members as a whole.
2. Does it contain new information that has not been published hitherto, or is it merely a restatement of research material?
3. Does it constitute an advancement in knowledge by clarification of past information?
4. Does it provide a re-assessment of known facts in such manner as to be readily understood by the industry as a whole?
5. Are the claims in the paper factually supported with definite, impartial test data and established experience?
6. Is the paper valuable as a reference work?

All members of The Wire Association are cordially invited to submit technical papers either for publication in "WIRE & WIRE PRODUCTS" during the year or for presentation before the Annual Wire Association or the Regional Meetings.

THE TWENTY-FIVE YEAR CERTIFICATES

These certificates of The Wire Association are being awarded by the Board of Directors at the Annual Convention of the Wire Association to those who have been members continuously for 25 years. These persons are:

W. M. AKIN, President
Laclede Steel Co.
St. Louis, Mo.

W. ROY MACKAY, Asst. Supt.
Rod and Wire Mills
Bethlehem Steel Co.
Sparrows Point, Md.

EARL R. POTTER, Pres. & Gen'l Mgr.
Industrial Wire Products Corp.
Los Angeles, Cal.

Plating Wire for Eye Appeal
Survey of Finishes and Processes

by R. T. Gore
Market Development Engineer
Metal & Thermit Corporation
Rahway, New Jersey

The volume of wire products which receive plated coatings has been constantly increasing. It is also true that the number of finishes which are being applied commercially has risen, due principally to the increasing popularity of the brass, bronze, and copper finishes. A brief tour through any store supplying from the lowest to the highest priced merchandise of this type provides ample proof of these facts.

★ ★ ★

The purpose of this paper is to present a survey of the plated finishes which are popular at the present time and to describe briefly the processes used in applying these coatings.

Preparation of the Product for Plating

One of the fundamental requirements for obtaining a high quality plated finish involves proper preparation of the work for plating. It is the opinion of this writer that more defective finishes are produced due to improper preparation than to faulty plating. In the simplest terms, this "cleaning" operation involves the preparation of a surface which is not only visually clean but also chemically clean. In the case of decorative wire products, the metal being prepared is almost always steel.

★ ★ ★

The types of contamination which usually are encountered fall into three classifications:

1. Oil, drawing lubricants, etc.
2. Surface oxide.
3. Weld scale (if product has been welded).

★ ★ ★

The removal of oily materials

R. T. Gore

This paper was prepared for delivery at the Symposium on Wire Plating at the Annual Convention of The Wire Association in Chicago on October 14, 1957. It discusses the chemicals and materials used in plating.

The author received a degree of B.S. in Electrochemical Engineering from Pennsylvania State University in 1934. After two years of graduate study, he taught physical chemistry at the University of Pennsylvania. He joined Metal and Thermit in 1951 where he has been concerned with electroplating, specifically tin and tin alloy plating. He has recently been given responsibility for all M & T plated and organic coatings and metals.

requires the use of alkaline cleaning compounds, which are rendered more effective by using them with electrical current, in other words, as electro cleaners. There are a great many proprietary compounds available for this purpose and they have varying degrees of strength and effectiveness. They are chosen to meet the specific conditions under which they must operate. If the amount of contamination to be removed is high, a degreasing operation in trichlorethylene or perchlorethylene prior to electrocleaning is advantageous.

★ ★ ★

Surface oxide and weld scale are generally removed by acid treatment. Hydrochloric acid with an inhibitor to prevent excessive attack on the steel is most often used. If only surface oxide is present, sulfuric acid may be substituted.

★ ★ ★

Many variations of the cleaning cycle are possible but a typical sequence follows:

1. degrease in trichlorethylene or soak cleaner.
2. acid pickle
3. electro clean (anodic)
4. acid dip (if acid plating solution follows) or cyanide dip (if alkaline plating solution follows.)

★ ★ ★

There should be abundant water rinsing between steps. This cycle would accommodate wire products which have all three types of surface contamination. It is a widely used sequence in job plating shops which must be prepared to meet a variety of conditions. In captive plating shops it is often possible to shorten the sequence.

Zinc Electrodeposits

To most persons concerned with the wire industry, the words "zinc" and "galvanizing" are synonomous. It is true that very large quantities of zinc are used for electrogalvanizing wire to provide corrosion resistance and considerable amounts are also consumed for the production of bright finishes on wire products.

★ ★ ★

Of all the metals that are deposited on wire products, zinc is the most inexpensive. This immediately gives it an economic advantage. It also has the advantage of

(*Please turn to page* 1291)

Electro-automatic Weighing-and Fillingmachines

"PRAEZI-BLITZ"

for the Wire Nail, Screw, Tacks and Metal Smallware Industries

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Types 2-15

for mass weighing of wire nails, tacks etc.
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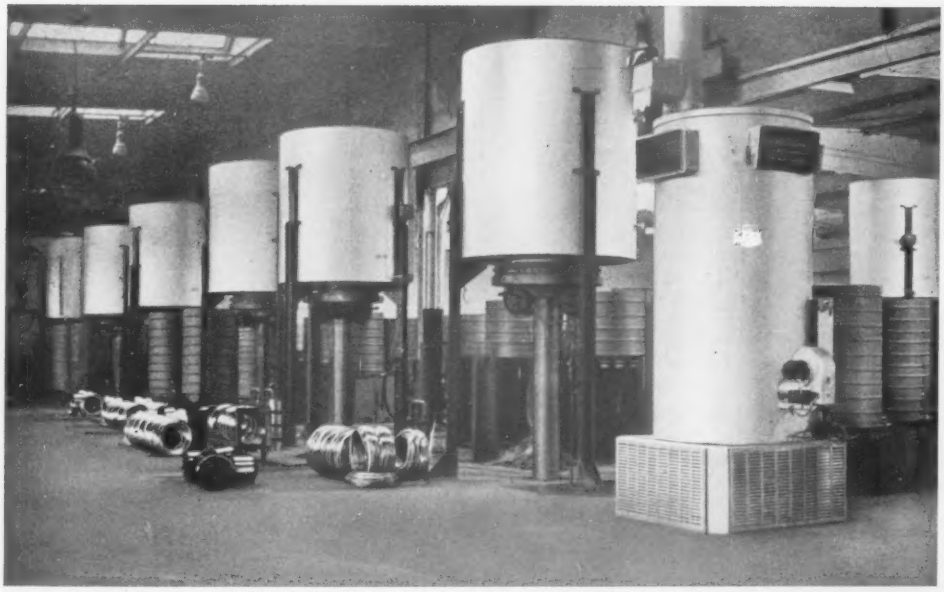

SEVERAL VACUUM BRIGHT ANNEALING UNITS WHICH WE HAVE INSTALLED IN ONE OF THE MOST IMPORTANT CABLE WORKS IN GERMANY

D.B.G.M. and Foreign Patents)

Galvanizing Furnaces heated by the cover with ceramic tube (Patent)

Continuous pull-through wire furnaces special design for short time heating (Patent)

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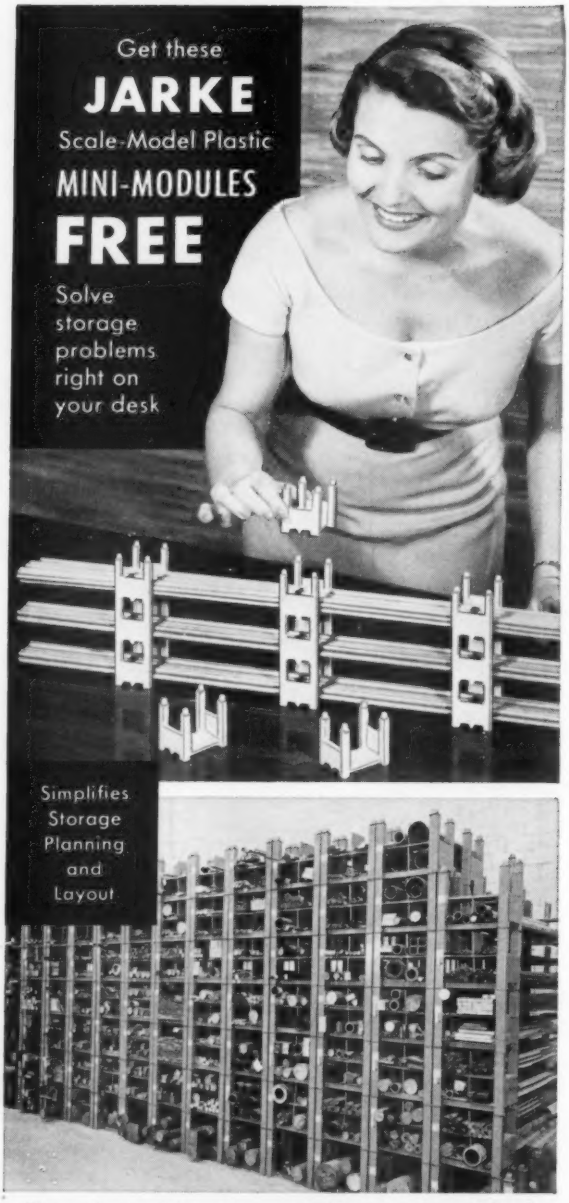

These plastic miniatures are actual 8-to-1 scale models of Jarke Mini-Module pre-fabricated stock storage racks. They nest into each other and can be set up on a desk top, in various ways, to determine the most efficient storage method, before actually re-arranging the stock room itself. Designed to show you the advantages of Jarke Modular Storage Systems, these handy units will save you time and labor when planning or revising storage of bar, rod and pipe stock.

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Stainless Steel Cold Heading Wire

(*Continued from page* 1197)

No. 8 shows the progressive steps of heading two different size nuts. In cold heading stainless steel nuts an adherent copper coating is particularly important since there are more operations than are encountered with other fasteners and, therefore, a greater chance for galling.

★ ★ ★

Adequate lubrication applied at the heading machine is also necessary to minimize tool wear. Lubricants similar to the grease type lubricants used for wire drawing are utilized in some heading shops. An example is a suspension of aluminum stearate in lard oil, a good boundary type lubricant for minimizing die scratches. This type of lubricant can be applied to the wire as it is fed into the header.

★ ★ ★

In order to better understand some of the problems involved in cold heading stainless steel, a description of the defects encountered in headed parts must be included. Split heads are caused by excessive seams in the wire. Figure No. 9, illustrating both stages in the heading of a recessed head austenitic stainless steel, shows how an excessive seam opens and results in a "split" head.

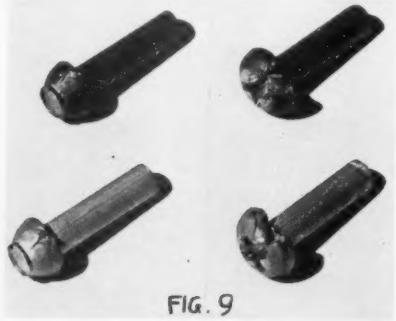


FIG. 9

This type of defect can be recognized best by first removing all coatings from the headed part. Notice that the seam can be traced along the wire and up through the split. Also, the direction of the split runs parallel to the axis of the wire.

★ ★ ★

Scratched or galled headed parts

may result from improper tooling setups or poorly coated wire. If scratching always occurs at the same spot on the finished part it is probable that the tooling should be investigated. Non - uniformly coated wire or a wire coating with poor adhesion will usually result in scratched parts, too. It is also possible that wire, as received from the producer, may occasionally contain scratches from the wire drawing dies. Such scratches from wire drawing seldom affect the cold headed product. In contrast to a seam a wire drawing scratch can be seen (without removing the surface coatings) as a narrow, shallow trough rather than a tight, sharp defect appearing as a line.

★ ★ ★

Lastly, stress cracks may arise from poor heading practice. See Figure No. 10. The heading operator should first check to ascertain that his dies are properly aligned to eliminate the possibility of forming eccentric heads. An off-center head formed during the first stage may result in excessive stresses in some portion of the head during the final blow. Cases in which wire has been considered defective were actually instances of improper heading techniques; in most cases the wire can be headed sucessfully after some adjustments are made.

★ ★ ★

If it is suspected that wire is of poor quality, proof of defective wire can best be demonstrated by showing that the wire will make defective heads while other similar wire can be successfully headed on the same machine setup. The consumer of stainless heading wire aids himself considerably when he assists the wire producer to establish deficiencies which cause poor headability. The wire manu-

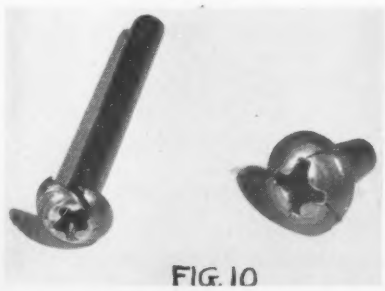
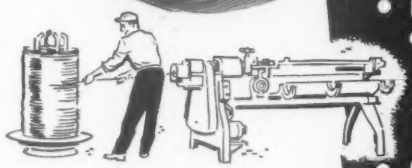


FIG. 10

WIRE

BACKED BY A HALF CENTURY OF EXPERIENCE



- **Sizes up to 9/16"...**
  . . . down to almost the size of a human hair, in low carbon and medium low carbon steels.
- **Wire of many finishes**
  the right wire for the job—coppered, tinned, bright, galvanized and other finishes to fit your production needs.
- **Better forming and workability**
  Continental Wire is available in almost any temper and analysis in low and medium low carbon steels for your particular forming jobs.
- **Metallurgical service**
  Thousands of case histories provide unsurpassed resources for developing a practical solution to your wire problems.

ECONO-COIL—Reduces scrap loss up to 90 percent. Saves material handling time. The Econo-Coil gives you continuous length wire coils of 2000# to 3000# catchweight, in sizes from 12 gage through ½" diameter. Shipped on returnable Econo-Coil pallets.

LEVERPAK—Mechanizes your wire handling, protects wire against moisture, dirt and handling damage. LEVERPAK permits long uninterrupted runs of 500# to 650#, depending on wire sizes. Saves scrap, downtime, stores easily.

SPECIAL SHAPES—D-shaped, V-shaped, oval, half-oval, half-round, square, rectangular, triangular, keystone-shaped and others. Saves fabricating and machining costs.

Chances are you have a problem right now that we can help you solve—with Wire. Call us.

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facturer must rely on service reports from his customer in order to upgrade wire quality and correct specific conditions. Only by freely exchanging information and ideas can the producer most completely satisfy the needs of the consumer.

★ ★ ★

In conclusion, stainless steel cold heading wire must be especially manufactured to control the many factors influencing cold headability. This is necessarily the job of a specialty steel mill. However, stainless steels, though difficult to cold head, can be headed profitably with the knowledge of certain precautions that are based on a sound metallurgical background.

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1. **Tyson, S. E., "Cold Headed Parts From Austenitic Stainless Steels", Materials and Methods, October 1956.**
2. **Lanphier, B. T., "Factors in Selecting Stainless Steels," Machine Design, July 1952.**
3. **Willis, J., "Deep Drawing", Butterworth Scientific Publications, London, 1954.**
4. **Wistreich, J. G., Cold Working of Metals, *Journal of the Iron and Steel Institute*, May 1955, p. 51.**
5. **Baldwin, W. M. and Beiser, C. A., Why Stainless is Hard to Cold Head, *Iron Age*, January 13, 1955, p. 82.**
6. **Acknowledgement is also made to Materials and Methods for permission to use certain photographs and material that appeared in the October, 1956, issue of that magazine in the article "Cold Headed Parts from Austenitic Stainless Steels."**

A Simplified System for Carbon Restoration

(*Continued from page* 1203)

Oxygen is eliminated by the use of exothermic, nitrogen carrier gases.

N_2

Non-reactive.

CO_2

Reacts with iron to produce iron oxide.

$$Fe + CO_2 = Fe\,O + CO$$

★ ★ ★

Reacts with carbon to lower carbon content (decarburizing).

$$Fe_2\,C + CO_2 = 3\,Fe + 2\,CO$$

★ ★ ★

CO_2 is eliminated by absorption in N_2 generator.

CO

Reacts slowly with iron to form iron carbide (carburizing).

$$3\,Fe + 2\,CO = Fe_3\,C + CO_2$$

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Breaks down at low temperatures to form CO_2 and free carbon (soot).

$$2\ CO = CO_2 + C$$

H_2

Reacts with iron oxide to reduce it to iron.

$$Fe\ O + H_2 = Fe + H_2O$$

★ ★ ★

May be absorbed by high carbon steels. Non-decarburizing if dehydrated.

H_2O

Reacts with iron to form iron oxide.

$$Fe + H_2O = Fe\ O + H_2$$

★ ★ ★

Reacts with carbon in steel (decarburizing).

$$Fe3C + H_2O = 3\ Fe + CO + H_2$$

★ ★ ★

Amount of H_2O in atmosphere gas is controlled by refrigerant and dessicant dryers in N_2 system.

Hydrocarbons

Definitely carburizing.

$$3\ Fe + CH_4 = Fe_3\ C + 2H_2$$

★ ★ ★

CH_4 is added to atmosphere by controlled addition of natural gas.

★ ★ ★

The reactions that takes place within the furnace with this system are as follows. On addition of H_2O by wet N_2 it is possible the following reactions take place:

$$CH_4 + H_2O = CO + 3H_2$$

This excessive CO reacts with the steel charge

$$3Fe + 2CO = Fe_3C + CO_2$$

following this

$$CO_2 + H_2 = H_2O + CO$$

★ ★ ★

Once the reactions are started no additions of H_2O are needed as the above reactions are self-supporting.

★ ★ ★

Carbon molecules of CO reacting with the Fe give the desired car-

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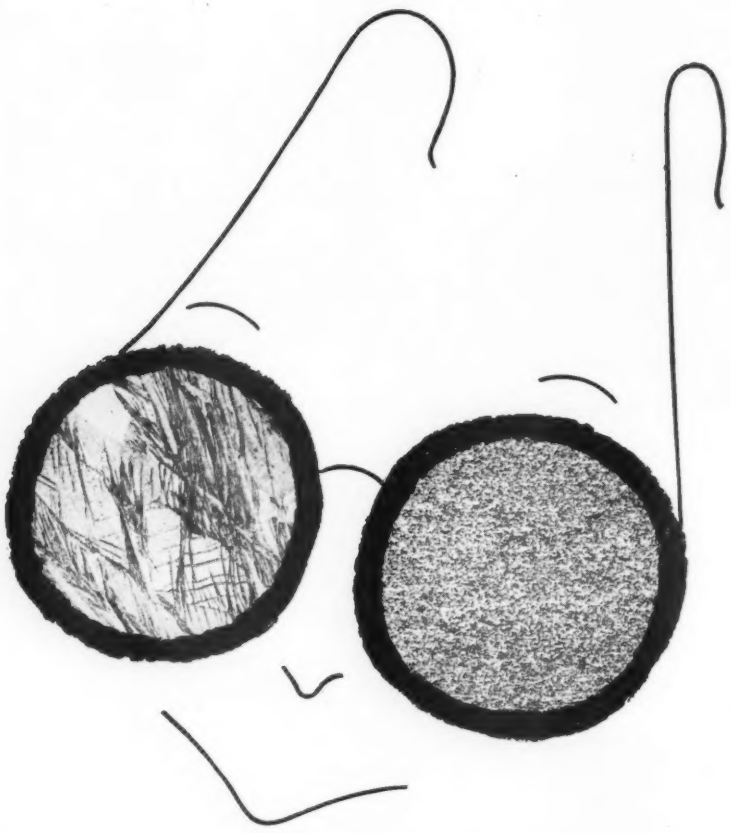

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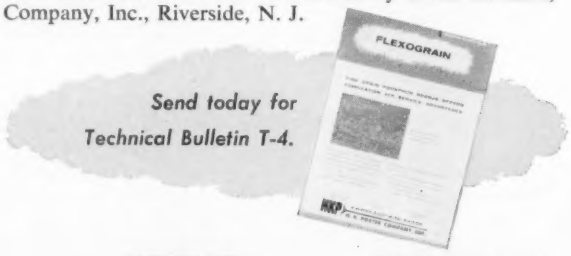

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bon potential and restoration.

★ ★ ★

One additional piece of information that may be of value is the amount of gas flow under normal loading conditions. A gas flow that will give three changes of atmosphere within the furnace per hour, at room temperature, is suggested.

★ ★ ★

Figures #5, #6 and #7 show

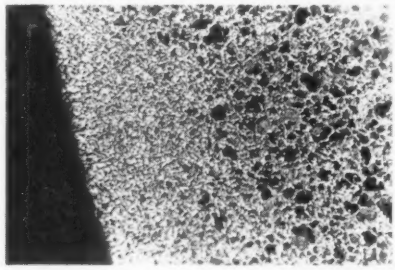

Fig. 5—Start of soak. Partial decarburization.

the carbon penetration we are able to obtain on 0.45 carbon steel. Figure #5 is a sample removed at the start of a soak. Figure #6 is a sample removed after two hours soak and Figure #7 is a sample after three hours soak. This was taken from a charge of 5000 lbs. of X1545 rod coils. The final product is usually within the range of

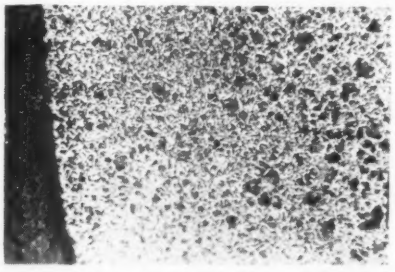

Fig. 6—After 2-hour soak. Start of restoration.

Figure #7, or can be kept within this range with approximately .001" partial decarb.

★ ★ ★

The original experimental work on this system was carried out in 1948 by Mr. J. L. Kozma, of Lee Wilson Engineering Co., Inc., whose article was published in the 1948 August edition of WIRE & WIRE PRODUCTS.

★ ★ ★

These experiments have been

continued to date so that now this practical and simplified method of carbon restoration can be used.

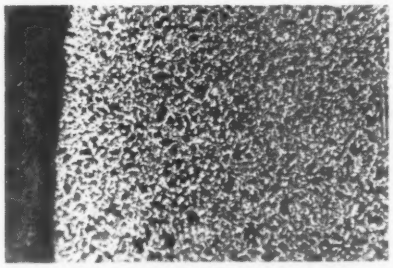

Fig. 7—End of 3-hour soak. Complete restoration.

A Method of Controlling the Contour of Tungston Carbide Dies Used in Drawing Copper Wire

(*Continued from page* 1206)

Measurement accuracy by the method thus far described is dependent upon the accuracy of the back relief, the gaging cone and particularly on the distance between the projected apex of the gaging cone and the flat surface that limits the plug gage travel when the plunger is fully depressed. Wear and inaccurate machining is compensated for by accurately measuring this distance with a depth micrometer. Using a simple formula, the inspector calculates a value for each particular assembly. This becomes the value at which the operator sets the dial indicator when the plunger is fully depressed. The cones are checked periodically and the value may be changed to compensate for wear. This reduces the critical aspect of the apex distance so that the cone has reasonable machining tolerances. It is important that sharp corners be maintained on the end of the plug gages. For each 0.001 inch wear on the tip diameter there is an error of 0.0115 inch on the measured bearing length.

★ ★ ★

There is a considerable amount of wear on the tip of the plunger. To maintain accuracy and add to the useful life of the plunger, care must be taken to set the dial indicator at a predetermined reading when the plunger is completely retracted rather than set the dial at zero when the plunger is fully

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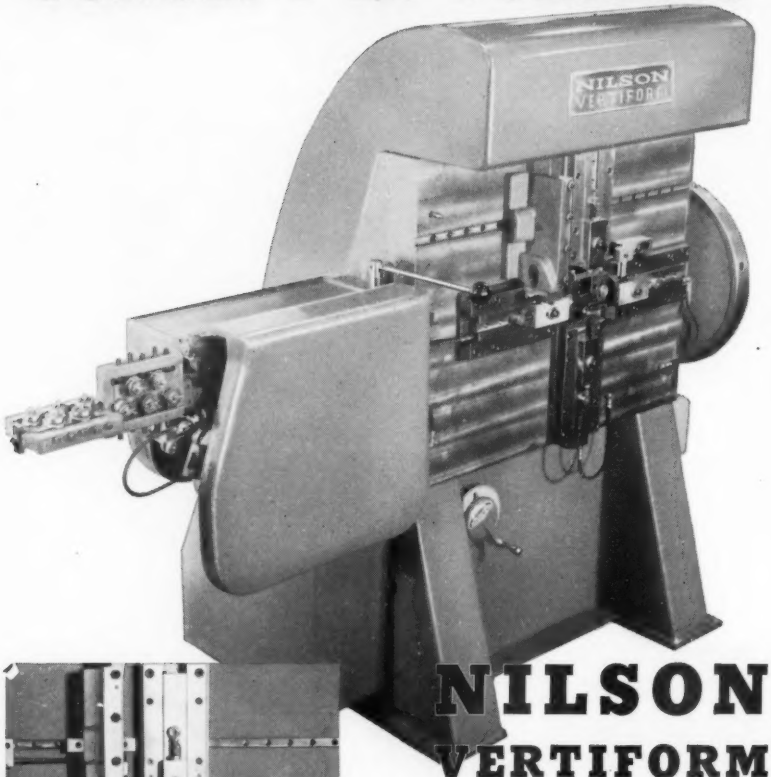

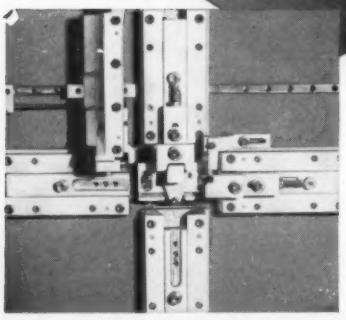

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extended. This is accomplished by placing a plug gage in position and depressing the plunger fully without having a die in position. With the dial indicator set in this manner, the reading obtained when measuring a die is dependent on the proximity of the plug gage tip to the cone instead of the distance

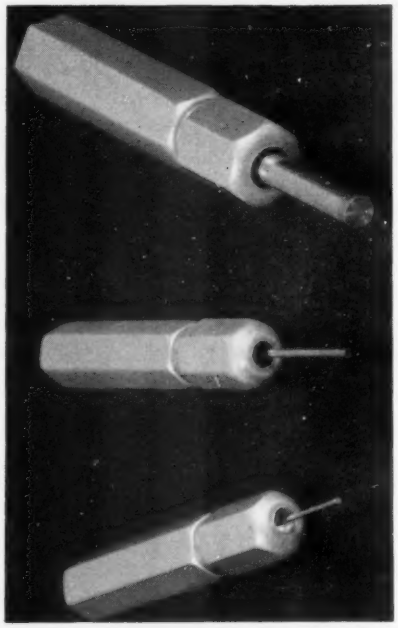

Fig. 3—Plug gages are hardened steel pins precision ground to accurate diameters. A variety of sizes are necessary to measure the many die sizes.

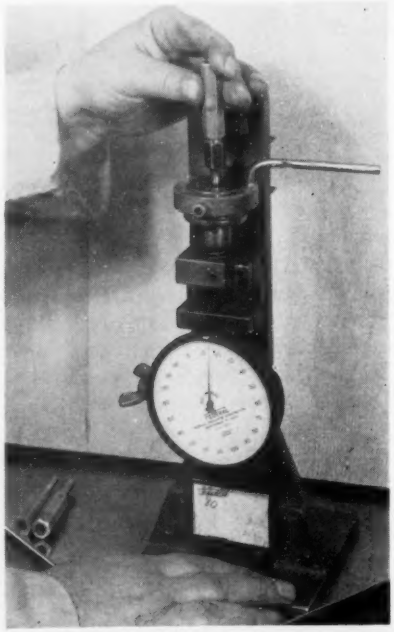

Fig. 4—During the recutting operation the dial indicator and plug gages are conveniently located for periodic checking of the dies.

the plunger has been depressed. Thus the length of the plunger and the distance it normally extends from the cone is not critical and may vary considerably with wear. However, the dial must be occasionally reset. Experience has shown that resetting the dial once each day is sufficient to maintain accuracy.

★ ★ ★

The remaining sources of possible inaccuracy in bearing length measurements lie with the operators who must be sure that the dies are made with straight conical surfaces of the proper angle. The correct plug gage must be selected for each die size and the correct setting must be selected for the dial indicators.

★ ★ ★

The entire assembly is mounted as a pedestal that may be moved about the Die Shop as needed. A rack holding the various plug gages is used in conjunction with the indicator gage.

★ ★ ★

The dial gage method of checking tungsten carbide die contours has proved itself in actual use. It is a fast, accurate, economical method that can be explained to and used by an operator with no previous experience in the re-cutting of wire drawing dies. It produces consistent die shapes from day to day and requires a minimum amount of maintenance.

Fig. 5—Heavy duty ripping machines are used for removing the rough sizing of tungsten carbide dies. The cone pointed pin is lowered into the slurry flooded die hole. The pin is rotated and oscillated to provide a cutting action. Actual stock removed is by the sharp corners of the silicon carbide particles in the slurry. * * * *

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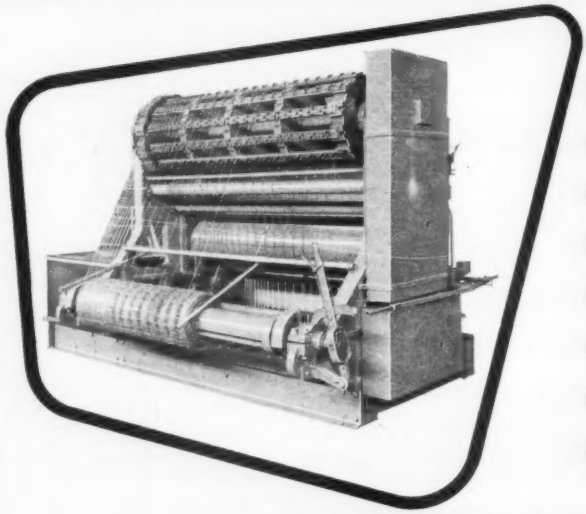

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Made Superintendent of Bethlehem's L.A. Wire Mill

George W. Morris has been named Superintendent of the wire department at **Bethlehem Pacific's** Los Angeles Plant according to a recent announcement by Plant General Manager, **R. J. Tremblay.** Mr. Morris was formerly Assistant Superintendent to **A. A. Olson,** who has taken over special engineering duties at the plant.

George W. Norris

★ ★ ★

Mr. Morris was transferred to Los Angeles in 1951 from Bethlehem's wire mill at Sparrows Point Plant, near Baltimore. He has been associated with the company for the past twenty-two years, exclusively in the production of wire. He is a member of **The Wire Association.**

★ ★ ★

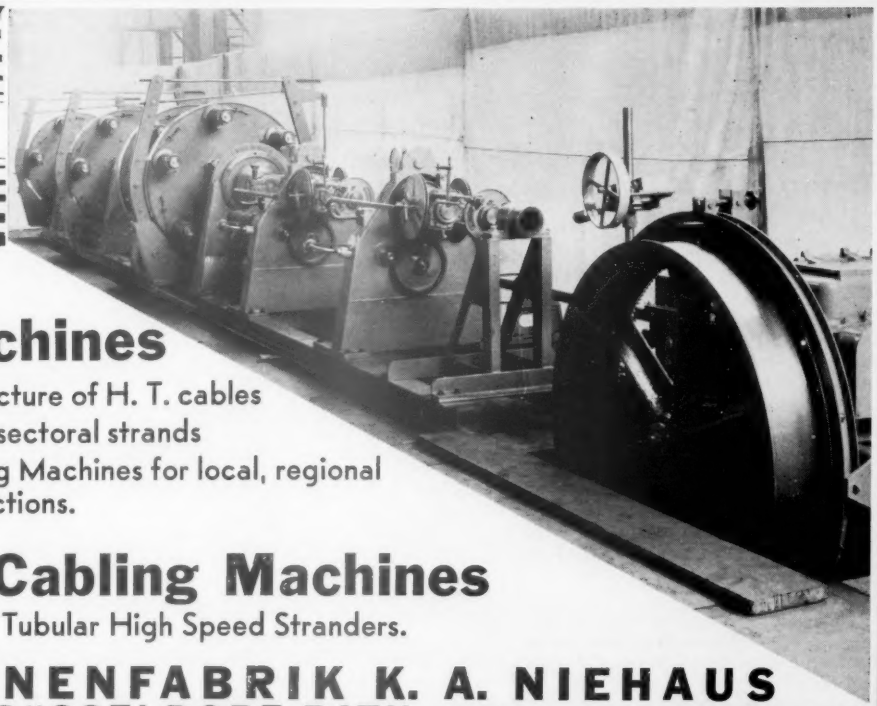
His experience includes the period 1935-1940 when the wire production industry experienced a major change from out-moded bench drawing type wire mills to today's high-speed continuous wire drawing machines for faster production of a higher quality wire.

New Appointment by Apex Alkali

The Apex Alkali Products Co., Philadelphia, has announced the recent election of **William B. Bauzenberger** to the position of Vice President in Charge of Sales.

William B. Bauzenberger

NIEHAUS



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Bill Bauzenberger has been associated with Apex Alkali for the last fourteen years, having first served as Western Pennsylvania Regional representative and eventually being moved to the home office to assume the duties of Sales Manager, the position he held at the time of his election to his present post.

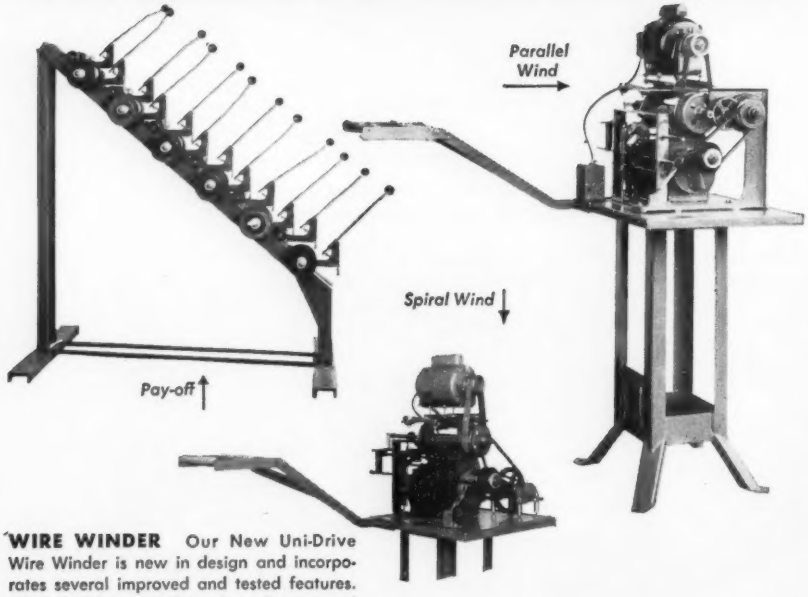
Made Works Manager by CF&I

William Mohr has been appointed Works Manager of the Pacific Coast Division of the **Colorado Fuel and Iron Corp.**, it has been announced by **J. J. Martin,** vice president in charge of operations, Western Division. He will make his headquarters at CF&I's Oakland, Calif. plant.

★ ★ ★

Up to the time of his appointment he had been Wire Mill Superintendent. Prior to that he had been a master mechanic at the plant. Mr. Mohr, who holds a Master's degree in architectural engineering, joined CF&I in 1935. A native of California, he is a member of the San Mateo Manufacturer's Association and of The Wire Association.

STANDARD UNI-DRIVE WIRE WINDER



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A Weldable Hardenable 12% Chromium Alloy

(*Continued fom page* 1226)

termediate anneal. No cracking or fractures occurred in the weld or heat affected areas. Six successive single drawing passes were used to draw to .098" diameter wire. The speed was approximately 100 F.P.M.

★ ★ ★

Tensile tests were conducted on the wire after the various cold reductions. These results are shown

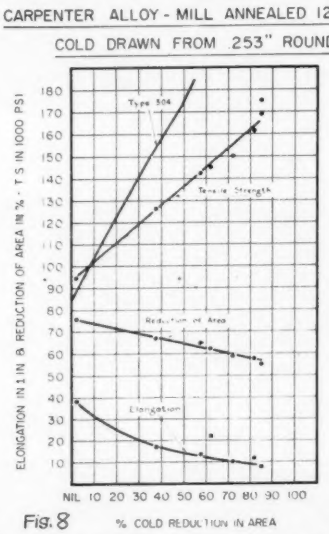

Fig. 8

in Fig. 8. Up to 85% reduction there is still no leveling off of tensile strength. The rate of work-hardening is similar to other 12.00% chromium alloys, but shows a much lower rate than austenitic alloys. With the increase in tensile strength there is a gradual decrease in ductility; however, even after 85% reduction in area, a good amount of ductility is retained. For this reason, it is believed that the welds could have been drawn at high speed on a continuous drawing machine.

★ ★ ★

Fig. 9 shows the effect of tempering on the wire after cold drawing 85%. This shows the properties of the weld area compared to the normal wire. These curves indicate that there is no significant difference in properties of the weld area and the normal structure. From the results of these tests it can be concluded that the alloy can be readily welded and cold drawn in continuous wire drawing operations.

Weld Rod

Lime coated weld rod was processed from 3/16" wire. To test the welding characteristics of the rod, pieces of the same analysis from heat B-02652 were electric arc welded. A 45° angle notch was

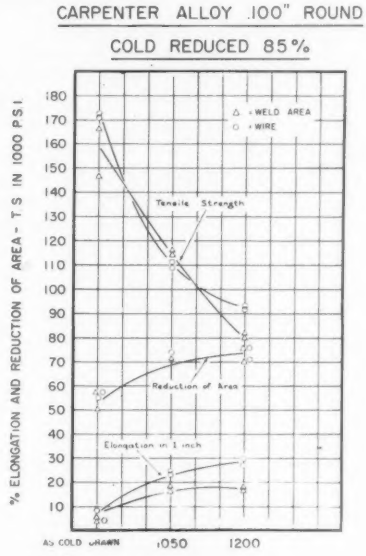

Fig. 9

machined on the pieces. The notch was filled by three passes of weld metal. The weld metal had good fluidity and very little spattering occurred. No preheating or post-heating was used. Examination of the weld upon cooling showed no cracks. Fig. 10 is a cross section

macrophotograph of the weld. The microstructure is fully-martensitic, with no visible traces of "delta ferrite," in either the weld bead or heat affected areas.

★ ★ ★

Tensile tests were pulled on the weld metal in the longitudinal directions. Subsized unnotched Charpy impact tests were also made longitudinally on the weld metal. Table V shows the results of these tests. In the as welded condition, the tensile strength is relatively high but the elongation and reduction of area values are low. After tempering at 1050°F and 1200°F, the ductility of the weld is restored.

★ ★ ★

The unnotched Charpy impact tests on the weld metal were excellent. Although the specimens were subsized, all the specimens were pushed through the impact machine without fracturing. As welded and tempered at 1050°F, the metal absorbed 180 ft-lbs. When tempered at 1200°F, 160 ft-lbs. were absorbed. The as welded specimen was tested on the 100-ft-lb. scale and stopped the pendulum completely without fracture. These tests indicate that the alloy in the welded condition has good properties and can be welded readily without pre-heat or post-heat treatments and have crack-free weldments.

TABLE V

TENSILE AND IMPACT PROPERTIES ON WELD FROM COATED ROD

Treatment	U.T.S. psi	Elong. % in 4D	RA %	Unnotched Charpy Impact Ft. Lbs.
As welded	161,200	2.4	6.4	100 +
Temper 1050°F	127,000	17.0	61.8	180
Temper 1200°F	110,400	18.0	63.8	160
1750°F O.T. 1050°F Temper	127,000	17.6	62.8	-

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strength, good ductility, combined with good weldability, enables the alloy to be used in many applications especially where joining is a problem. It is now possible with this alloy to weld and continuously cold draw a 12.00% chromium steel. At the present time this alloy is being tested in steam turbine applications for turbine buckets, blades, and bucket covers. It is also possible that this alloy may be used in strip, sheet, and wire applications where austenitic stainless steels are being used because of forming problems.

Acknowledgment

The author gratefully acknowledges the technical advice of **John H. Corson,** the help of **W. Ziolkowski** for the carrying out of the mechanical tests, and of the **John A. Roebling's Sons Corporation** for the upset butt welding of the wire. The weld rod was processed by the **McKay Company.**

References

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Vol. 74, (1952), pages 765-771.

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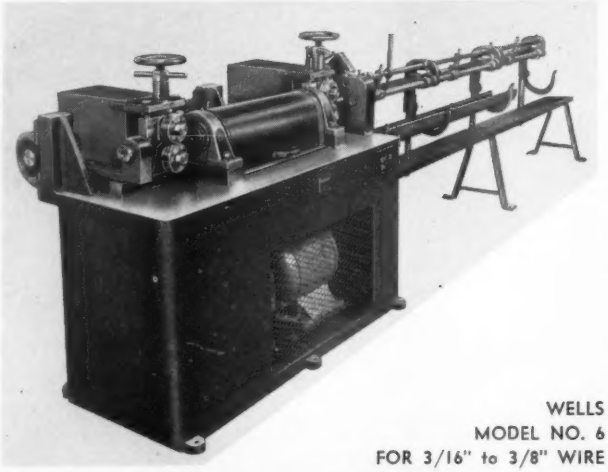

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1. The names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, Richard E. Brown, 453 Main Street, Stamford, Conn.; editor, Edmund D. Sickels, 453 Main Street, Stamford, Conn.; managing editor, none; general manager, Ruth S. Spengel, 453 Main Street, Stamford, Conn.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.) Quinn-Brown Publishing Corporation, 453 Main Street, Stamford, Conn.; Richard E. Brown, 453 Main Street, Stamford, Conn.; Leta B. Brown, 1045 Summit Road, Montecito, Cal.; Ruth S. Spengel, 453 Main Street, Stamford, Conn.

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5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly, semi-weekly, and triweekly newspapers only.)

RUTH S. SPENGEL
Treas. & General Manager

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HAZEL R. RANDLETT
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A Review of Recent Wire Patents

The data listed below is only a brief review of recent patents pertinent to the readers and subscribers of this publication.

Complete copies of these patents may be obtained by writing to the publisher of this magazine and remitting 50c for each copy desired. For orders received from outside the United States the cost will be $1.00 per copy.

No. 2,801,559, BENDING MACHINES, patented August 6, 1957 by John Henry Hawes, London, England, assignor to Hilmor Limited, London, England, a British company.

A three-point bending machine is disclosed including a ram to engage a forming tool, a guide for guiding the ram and forming tool along a straight path, an adjustable mounting member mounted in the guide at the end of the path remote from the ram. There is also a lock for the mounting member relative to the guide.

★ ★ ★

No. 2,801,565, IMPROVEMENTS IN PICTURE WIRE, patented August 6, 1957 by Edouard A. Nicollet, Douglaston, New York.

The wire is characterized by a central core wire and an outer covering of strands of solid wire so applied that the covering protects the core and both share in carrying the load.

★ ★ ★

No. 2,801,669, APPARATUS FOR COILING SPRING MATERIAL, patented August 6, 1957 by Basil Lermont, New York, New York, assignor to Eastern Metals Research Co., Inc., New York, New York, a corporation of New York.

An object of this invention is to provide apparatus for forming springs having constant tension or varying tension characteristics. Flat wire or strip springs are especially indicated.

★ ★ ★

No. 2,801,679, VENTING SPRING CUSHION, patented August 6, 1957 by Samuel P. Crane, New York, New York, assignor to R. O. Kent Co., New York, New York, a co-partnership consisting of said Crane and Stephen D. Kent.

This cushion, is adapted to be used between the body of an occupant and seat back and seat bottom of a vehicle and the like and includes a zig-zag wire structure.

★ ★ ★

No. 2,801,680, VENTILATING SPRING UNIT, patented August 6, 1957, by Samuel P. Crane, Great Neck, N. Y., assignor to R. O. Kent Co., New York, New York, a co-partnership consisting of Samuel P. Crane and Stephen D. Kent.

This patent is related to Patent 2,801,679 and includes a different arrangement of the rows of wire coils.

★ ★ ★

No. 2,801,681, VENTILATING CUSHION, patented August 6, 1957 by Samuel P. Crane, Great Neck, N. Y., assignor to R. O. Kent Co., New York, N. Y., a co-partnership consisting of said Crane and Stephen D. Kent.

Here a special interlock of the intersecting wire coils is effected.

★ ★ ★

No. 2,801,682, SEAT CONSTRUCTION, patented August 6, 1957 by Annette E. Fridolph, New York, N. Y., assignor to A. B. A. Specialties Company, Inc., New York, N. Y., a corporation of New York.

A bolster effect is provided without radical departure from the usual seat construction.

No. 2,801,805, METHOD AND APPARATUS FOR WINDING POTENTIOMETERS, patented August 6, 1957 by Curt I. Johnson, Vestal, N. Y., assignor to International Business Machines Corporation, New York, N. Y., a corporation of New York.

There are six method and seven apparatus claims. In the method a length of wire is formed into a helix to produce the element and fed onto a supporting device while regulating the rate of feeding.

(*Please turn to page* 1273)

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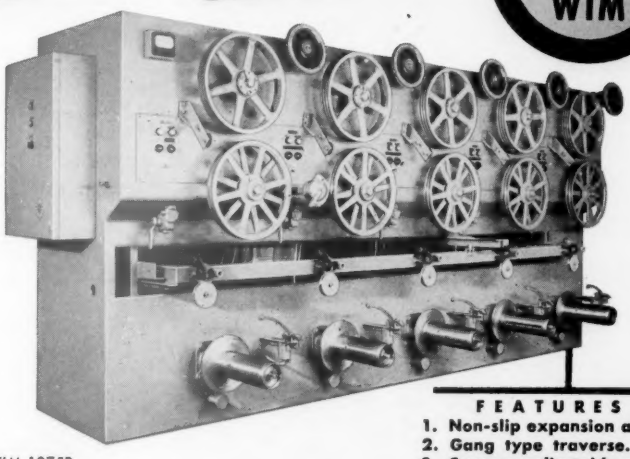

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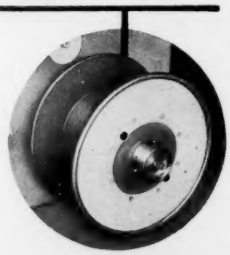

Close up view of 5" inch 3 Jaw non slip expansion arbor.

WIM

WIRE INSULATING MACHINERY, INC.

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35 HUDSON ST. NORTHBORO, MASS.

Combined Hot Rolling and Patenting of Rod

(*Continued from page* 1182)

signals operated together to open or close motor-operated valves supplying water to the first cooling stations (Fig. 5). The electrical system was designed to have a "memory" so that after each rod was coiled the water valves returned to the proper setting for the start of the next rod. This setting was based on the settings required at the start of previous rod coils.

★ ★ ★

The panel for the control of temperature is shown in Fig. 7. Typical temperature records are presented in Fig. 10. This figure shows that the rod temperature leaving No. 14 pass varied 100°F along its length but that ahead of the fourth cooling station the temperature variation was only a few degrees. This result was obtained by the operation of the automatic temperature control.

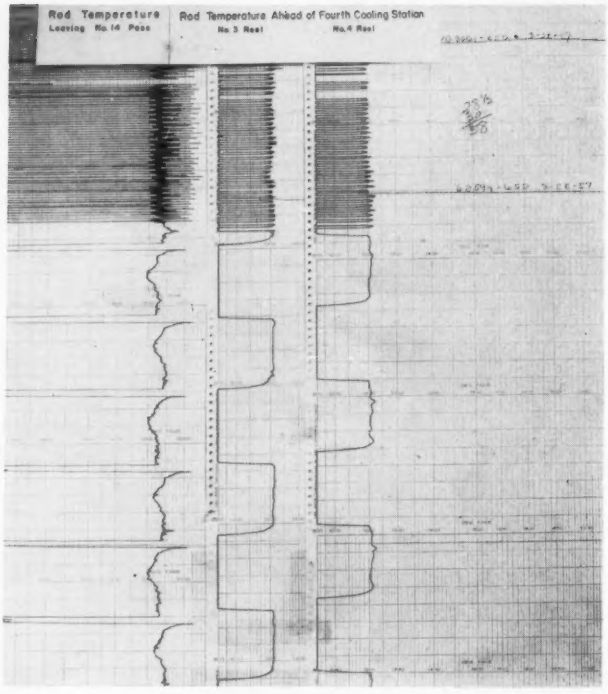


Fig. 10 — Temperature records. Lower part of chart was run at high speed to show temperature variation along length of each rod coil. Alternate coils went to No. 3 and No. 4 reels. Note large variation in temperature at No. 14 rolling pass compared with small variation after cooling with automatic temperature control.

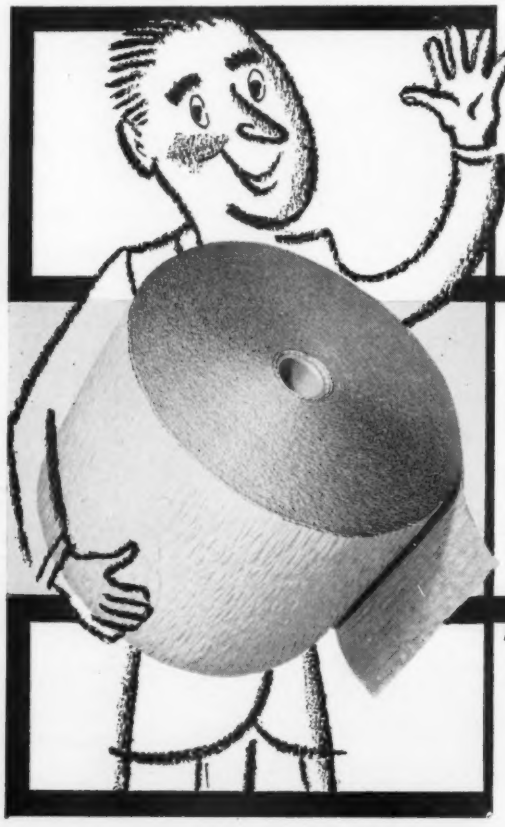
★ ★ ★ ★ ★

Reduction of Scale

Rod patented on the rod mill not only has an improved microstructure but it also has much less scale than conventional rod.

★ ★ ★

Practically all the scale on hot rolled rod forms after it is reeled. The time from the final roll pass to the reel is extremely short, also the rod is shielded from the air by the guide pipes and the water



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cooling. Consequently the lower the reeling temperature the lower the amount of scale. A study was made of this relationship and the results are shown in Fig. 11. It

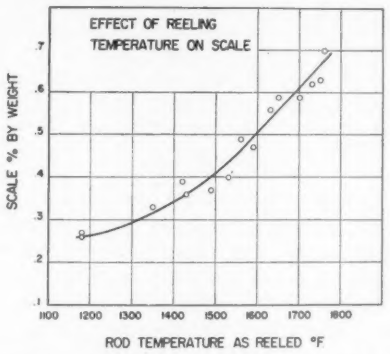

Fig. 11—The amount of scale on rod is reduced by reeling at low temperatures.

will be seen that rod reeled at 1200°F had only about ¼% of scale by weight. The amount of acid used in pickling is proportional to the scale on the rod. When inhibitors are used, nearly all the iron in the acid comes from the scale. The acid is discarded when the iron content reaches some limit set by the mill. Thus there is a saving of acid in proportion to the reduction of scale. It was found that there was a saving in cleaning time and acid consumption when rod patented on the rod mill was used. It was also found that there was an improvement in die life in the wire mill.

Present Status

More than 2500 tons of high carbon rods have been patented by this method. Practically all of this was drawn more holes than was possible with hot rolled rod, thus saving a patenting operation.

★ ★ ★

The cost of patenting varies from mill to mill. Based on a conservative figure of $10 per ton there is a considerable saving available for any tonnage which can be treated in this way in order to avoid a subsequent patenting.

★ ★ ★

The saving of scale is available for all tonnage of both high and low carbon. For example, if the scale saving is ¼% and the rod is worth $100 per ton, the saving is $0.25 per ton, which is a substantial figure on the annual output of a rod mill.

★ ★ ★

There is also an advantage in applying this heat treatment to low carbon tonnage because the carbides are present in a finely divided state. Such a microstructure assists when extensive cold work is required.

★ ★ ★

At the present state of the art the product is not fully equivalent to conventional patenting. The process is considered as a means for increasing the amount of raw ripping of hot rolled rod to about 75% reduction in area for 0.75% carbon rods and larger reductions for lower carbons. Rod patented in this way is used in cases where wire drawing is followed by a second patenting. The process is not suitable for final patenting without further refinement.

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the NEW material that withstands hi-speed pressure of wire by the tons
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3. U. S. Patent, No. 459,903.
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Plating Wire for Eye Appeal

(*Continued from page* 1200)

Zinc Plating

This plating operation follows the same pattern for cleaning, rinsing and pickling as the initial steps for copper-nickel-chrome plating.

★ ★ ★

The zinc metal concentration is five ounces per gallon of solution, fifteen ounces of sodium cyanide per gallon of solution, and eleven ounces of caustic soda per gallon of solution. This solution is operated at room temperature. The cyanide in this solution is the catalyst to aid in transferring the zinc metal from a solid to a liquid in the plating solution. The caustic soda aids in increasing conductivity, thus increasing plating efficiency.

★ ★ ★

Voltage used in this tank is 6 volt, direct current, at 50 amperes per square foot of work area. The best ratio in plating zinc is 1:1, that is, the surface area of the cathode is the same as the surface of the work being plated. The zinc metal, in the form of 2" cast balls, is placed in racks at the sides of the tank. The zinc in these anodes is better than 99.5% purity of metal.

★ ★ ★

The procedure just outlined will plate an average thickness of .0004" in thirteen minutes.

★ ★ ★

Following the zinc bath is a cold running water rinse.

★ ★ ★

After rinsing the work, it is dipped in Promat's Proseal Chromate bath. The purpose of the chromate dip is to chemically polish the zinc which has just been applied and at the same time deposit on the zinc a protective zinc chromate film which retards oxidation. Zinc is a very active metal and without this coating would soon discolor and be unattractive so far as appearance is concerned.

★ ★ ★

This solution is applied at room temperature.

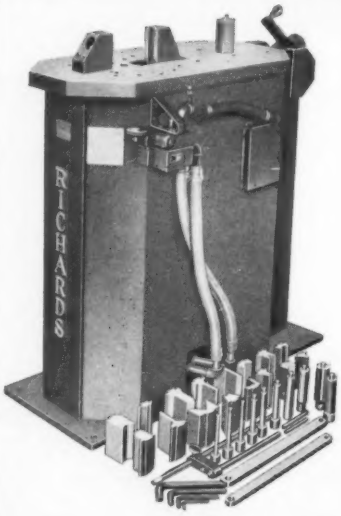
★ ★ ★

The work is now rinsed in cold water.

★ ★ ★

The next operation, which is actually the second phase of polishing, is a solution of soda ash. This is made up in 2 ounce per gallon concentration. This solution is a leach which changes the yellow hexavalent chrome to bright, lustrous trivalent chrome

MULTIFORM BENDERS



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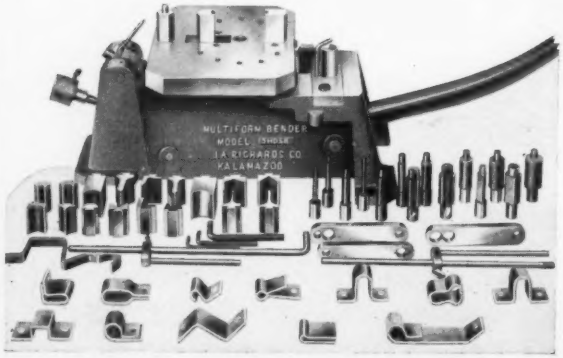

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which adds to eye appeal and greatly prolongs the good appearances of the finished product.

★ ★ ★

The last operation on this operation of zinc plating, is a cold water rinse, followed by a hot water rinse. The hot water rinse aids in sealing the protective film and also aids in preventing water marks.

★ ★ ★

In the past few minutes I have given you the procedure for plating copper-nickel-chrome and zinc. Regardless of the metal being plated there are some things which must be considered if the plated surface is to be attractive.

★ ★ ★

One of the important items in producing a good plating job is the matter of maintenance. This applies not only to plating solutions but the periodic cleaning of plating racks, tanks, anodes and electrical contacts and bus bars. Dirt at these points can produce rough, dull, or non adherent plate.

★ ★ ★

Cleaners should be dumped when they are weakened due to prolonged use.

★ ★ ★

Metallic solutions such as copper, zinc or nickel should be filtered as frequently as required. We find that with our copper solutions, filtration once a week is sufficient. Our nickel tank is filtered continuously at the rate of 6800 gallons per hour.

★ ★ ★

Our nickel tank contains nearly 7000 gallons. Thus we have filter capacity to filter our entire solution in approximately an hour and a quarter.

★ ★ ★

I would like to emphasize the fact that the procedures I have outlined are the ones used in our plant. Naturally you will find differences in our methods when compared with other plants. However, the broad, general procedures are the same in all plating plants.

Resigns as Works Manager

William D. Bawden has announced his retirement from **The Gilbert and Bennett Manufacturing Co.**, Georgetown, Conn., as of July 1, 1957.

★ ★ ★

He will continue to serve the wire industry as a consulting engineer, with offices at Belden Hill, Conn. Mr. Bawden ("Bill" to his many friends) has been with Gilbert and Bennett for the last 15 years, for the past five of which he was Works Manager. Prior to that he had been with **American Steel and Wire** in Trenton, **Republic Steel** in Chicago and **Reynolds Wire** in Dixon, Ill.

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Recent Development in Steel Wire Drawing Machinery

(*Continued from page* 1231)

type continuous machines built in several model variations. (Figure 14). Additionally, the Ringblox, a

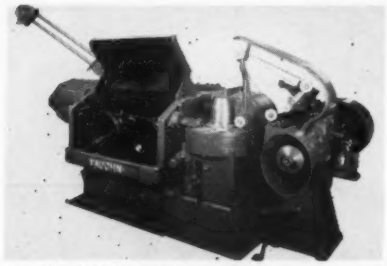

Fig. 14—12 HIC Continuous Machine.

wet drawing slip type, circular tandem machine, with tungsten carbide carriers, appears in five different models and is used primarily on finer sizes. (Figure 15). On the drawing boards is a machine embodying many of the principles of the Ringblox, but designed for the specific purpose of finishing .0059" tire wire.

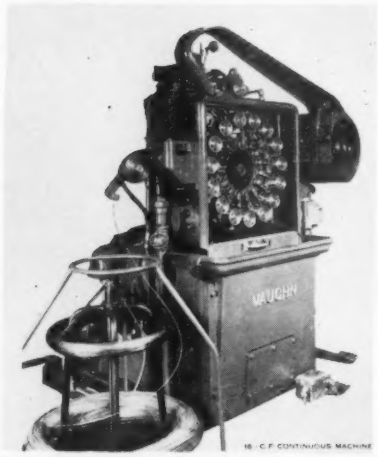

Fig. 15—16-CF Continuous Machine, Cover Down.

At the present time, in the steel wire drawing industry, most wire is taken up in coils around block pins on the finishing block of the machine. Stripping is accomplished by the insertion of a collapsible block stripping spider or a hook into the eye of the coil. With the increased emphasis on larger and larger bundles, however, many people have gone to the riding type block stripping spiders, either collapsible or non-collapsible.

★ ★ ★

For those who prefer to use the spider as a carrier, revolving pallets and pay-off rings have been developed to facilitate using the spider as a pay-off reel for the next operation. (Figure 16). Because riding strippers sometimes suffer undue abuse in subsequent handling, some people prefer to transfer the bundle immediately to a carrier and thus reduce the investment in strippers. For this purpose, an automatic dumping device has been added to the riding stripper.

★ ★ ★

To assist in obtaining large coils, push-up blocks often have been included as part of the finish block assembly. Some thought has also been given to adding a stationary block at the end of the machine. For finer sizes, cartons used as pouring reels are gaining wider acceptance.

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★ ★ ★

For some applications, spoolers are used. Some of these spoolers involve the use of the cardboard core type of spool, while others use conventional spools of either the permanent or throw-away type.

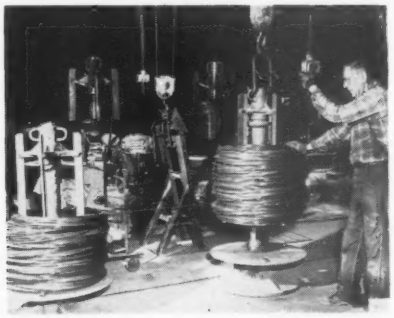

Fig. 16—Riding Type Stripper with Pallet as a Pay-off.

In connection with spooling requirements, a double spooler has been developed. (Figure 17). Lately, there has been a trend towards spooling even the larger sizes.

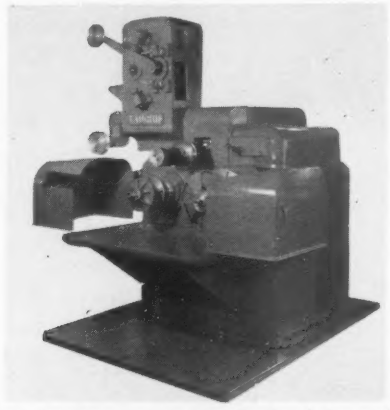

Fig. 17—Double Spooler for Cardboard Cores.

In all the phases of wire drawing development and progress, minimized handling is the primary concern today. Inevitably, the problem then boils down to the question of how much can a man be expected to do in a given period of time. With a higher over-all operating efficiency, it is still desirable to strike a good balance between machine and manpower efficiencies.

★ ★ ★

The responsibility for future progress lies primarily with the wire mill operators, the wire drawing machinery manufacturers, and the compound and die suppliers. With the machinery, compound, and die people, progress is essentially a leap-frogging proposition where improvements in one area may temporarily supersede the capabilities of the others. But for any of us to go forward, it is necessary that the wire mill operators should demand more, for in a large sense, the suppliers to the industry are just the tail of the dog.

★ ★ ★

For example, as far back as 1932, Vaughn's, seeking to be progressive, patented a stationary block. The demand was something less than sensational because the development was premature for the industry's demands. Today, interest runs high because larger bundles can be more easily handled.

★ ★ ★

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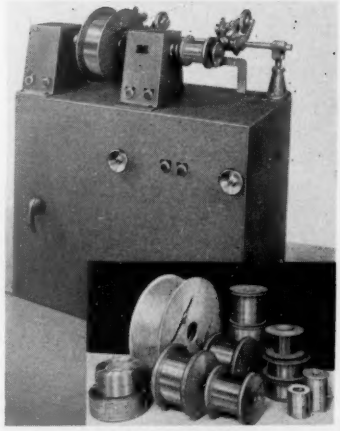
Announcing

The Completely NEW Robert J. Emory SPOOLER

The New Model 1900-HVE Multi-Spindle SPOOLER, engineered to include the revolutionary U.S. Varidyne Power System, assures increased production, complete flexibility of adjustment, uniform wire tension and extremely close winding.



Each strand of wire lays parallel, with no overwinding or underwinding—and no tight or loose spaces. Each spindle is powered with a variable-speed AC motor, each of which can be stopped or started independently of the master power unit.

The 1900-HVE Spooler is a rigid, precision machine that will produce a uniform dense lay of wire consistently. It is completely adaptable to constant or changing demands. Adjustments can be made accurately with the spooler in operation and without tools. All controls are positive.

SPECIFICATIONS

Size Range: .010" to .080" or heavier if soft, and many flat wire sizes.
Max. Spool Size: 16" flange diam.
Capacity: Usually 4 to 10 spindles.

Your special requirements can be incorporated in the design.

You are invited to consult us on your wire spooling problems. Our engineering resources and 60 years of experience are at your service.

ROBERT J. EMORY COMPANY

31 EAST RUNYON ST. • NEWARK 5, N. J.

SPECIALISTS IN WIRE SPOOLING MACHINERY

as manufacturers, have in some instances been guilty of permitting specific customer conditions and circumstances to figure too heavily in the over-all design and productivity of our equipment. Under these circumstances, it is up to us to do our level best to give the customer the benefit of our experience and the knowledge derived therefrom.

★ ★ ★

For the higher drawing speeds, which most certainly are coming, we are concentrating much of our attention and research to the question of providing adequate over-all cooling. The thing to bear in mind is that if any of us are permitted to look back, thirty-five years from now, to what constitute our present operating methods, they will seem just as antiquated as 1922 methods seem to us today.

Bulletin on New Spring Coiler

Sleeper and Hartley, Inc., Box 1249 Worcester, Mass., has issued a bulletin on its new No. 3 Universal Spring Coiling machine.

★ ★ ★

This is an escapement type with automatic cycling, extending the feed range far beyond the limitations of previous models. The escapement principle provides new speed and precision of manufacture. An even ratio feed of from 1:1 to 14:1 determines the basic range of the machine. It will handle wire from .092″ to .283″ in diameter. Copies of the bulletin may be had by writing the company.

Rod & Wire Coil Handling System

The Lee Wilson Engineering Company, Inc., has announced a new, improved, complete and automatic handling system for rod and wire coils. The system enables one man to quickly and efficiently prepare the coils for annealing and handle the coils after annealing. It includes all the equipment necessary from special crane tongs to improved unitized spider. The system is discussed in a new brochure available by writing the Lee Wilson Engineering Company, Inc., 20005 West Lake Rd., Cleveland, Ohio.

Appropriate Rods for Appropriate Wire

(*Continued from page* 1212)

open hearth steel stock; the same applies to screws, special hooks used in wooden rolling shutters and another type of hooks, to cold-flattened wire, and a few other items.

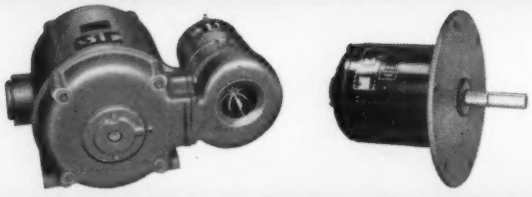
★ ★ ★

As a conclusion, whereas some years ago there were a lot of mild steel wire uses for which one could not do without open hearth steel, to-day such cases seem to be comparatively rare occurrences.

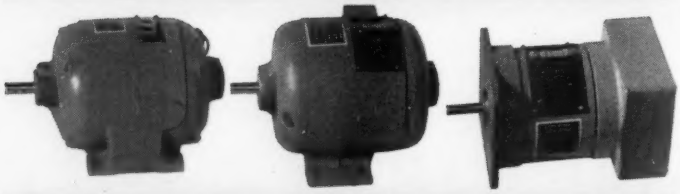
B. Carbon Steel

Switching over from mild steel to carbon steel, basic bessemer, on account of insufficient torsions and mechanical properties in general, is usually out of the question. Bekaert's always produce their high resistance wire from solid or molten charge open hearth steel, or from electric furnace steel, obtained either purely from scrap, or in a duplexing process using basic

WESCHE TORQUE MOTORS & VARIABLE SPEED DRIVES



. . . FOR TENSION CONTROL IN REELING & SPOOLING.



THE B. A. WESCHE ELECTRIC COMPANY
9027 SHELL ROAD
CINCINNATI 36, OHIO

Recent developments in the design of Wesche Torque Motors, and their related controls, permit closer tension control and wider speed ranges for winding duty and related services. In many cases a Wesche Torque Motor, installed at the point where power is needed, will simplify the construction of a machine and reduce its cost.

These Wesche Motors are custom-built and can be arranged for any type of service with mountings to suit design requirements.

Wesche engineers can help you with your torque motor and brake requirements for manufacturing or re-building of wire reeling or winding machinery. Ask for Bulletin BAW 5-6.

bessemer, normal or special, as molten charge. In this field then, there are no specific problems worth mentioning.

★ ★ ★

Just a few words, however, about Swedish rods and the controverse on this subject.

★ ★ ★

As long ago as 1936, at the Wire Convention held in Cleveland, Mr. Fisher presented a paper prepared by **J. W. Rockefeller, Jr.** on "The Selection of Wire Spring Materials". A long and thorough discussion ensued—Messrs. Westphal, Mac Carthy, Lewis, Voigtlander, Fisher and others taking part in it. This discussion centered around a question put by Mr. Westphal: "Why cannot a basic steel be developed that can supply some of these higher-cost rods and billets?" (he having in mind "Swedish" rods and billets).

★ ★ ★

The opinion **K. B. Lewis** held at the time on the subject had not changed very much in fifteen years time and is expressed in his book in a pithy way: "I know Swedish steel tends to be better than ours. It was ground into me at college and in my early steel days that Swedish ore is extremely low in phosphorus and, being smelted without coal, is practically free of sulphur when it becomes pig." (By the way, at present Swedish steel is no longer charcoal-steel, as it has been for a long time; the use of charcoal in preparing pig iron has become obsolete, because it was no longer an economical proposition; to-day Swedish steel is obtained from "sponge-iron", this being the product of reduction of pure ores by purified gases) (19). "I know that the conditions we have to induce in the bath in order to reduce these elements tend to promote the absorption by the steel of gaseous impurities and their compounds in solid solution and that these are fatal to uniformity and prevent our steel from attaining that quality edge that permits a steel to go on performing after it ought theoretically to have failed. I see all that, but I don't see what bearing it has on surface perfection, and that's what the Swedes have and we hope for" (1).

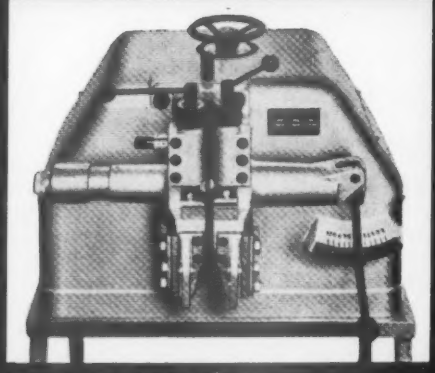
★ ★ ★

Swedish and American rods have not been compared in Bekaert's works, but only Swedish rods and those obtainable in Western Europe. Although phosphorus and sulphur are usually much lower in Swedish steel, and nitrogen as well as tramp alloys slightly lower, it would probably not be impossible to get from a few highly specialized Western European steel plants rods with a comparably satisfactory analysis. Also as to what regards segregations, inclusions, and other steel characteristics, it is—if not altogether easy—probably not absolutely impossible to produce steel that stands the comparison with the Swedish product. Not at a lower price, however. And when it comes to surface condition, Swedish rods are unequalled. Besides,

SCHLATTER

the world's leading wire welding machines

Schlatter welders, provided with automatic annealing-device, will give perfect welds on high carbon steel and patented wires.



Wire butt welder type M

for steel, brass, aluminium and copper.

Welding range:

Steel . . . . . 0,157" — 0,512" ø

Copper . . . . . 0,157" — 0,374" ø

wire welder type E

Four different models for butt welding of steel, copper, brass and aluminium.

Welding range:

Steel . . . . . 0,039" — 0,315"

Copper . . . . . 0,039" — 0,236"

H. A. SCHLATTER LTD ZOLLIKON/ZÜRICH (SWITZERLAND)

Manufacturers of electric welding machines

Sole Representative: Paul Reicher Machinery & Equipment, P.O. Box 127, Willowdale, Ont., Canada

even without our always being able to tell exactly why, the fatigue properties of the wire drawn from Swedish rods are nearly always at least a little better than those of wire made from non-Swedish raw material. This applies especially to fine wire, in which case the perfect repartition of even minute inclusions, the absence of aluminum, the sole use of silicon and other precautions, are probably part of the explanation. Also, if two pieces of coarser wire, one from Swedish and one from Western European steel, are submitted to the very hard test of alternate torsions (one right hand full turn, one left hand, and so on), there often is a tremendous difference to be noticed.

★ ★ ★

At any rate, there is no question but that Bekaert's, after experimenting for years and years and comparing time and again, would ever think of foregoing the use of Swedish rods in such cases as aircraft cord wire, card wire, highest quality hoisting rope wire, steel cord for tyre-reinforcement, piano wire, and similar uses.

5. Rod Problems Lying Ahead

Before concluding, a word about some rod appropriateness problems lying ahead of us will not, it is believed, be out of place.

A. Mechanical Descaling

Proof that a wire mill can be run without pickling plant is given day after day in several Western European mills at present, and there is no indication whatever that the trend towards doing away with acid will discontinue. This gives rise to a problem of rod appropriateness for descaling, the main requirement being a sharp dividing-line between oxide layers and base metal (20) (21). The means for obtaining this clear partition is: appropriate cooling of the hot rolled rod (22).

B. Continuous Casting

An experimental outfit for continuous casting is being erected in Belgium at present and should even be ready to make the first test-casts before long (3). According to information available, at least some fifty outfits for continuous steel-casting are reported in operation. Only one or two of them however are specializing in the production of small-size billets well suited for feeding a rod mill. At least one of them is located in the U.S.S.R., a country that is said to have projects for continuous casting of not less than some twelve million tons of steel per year.

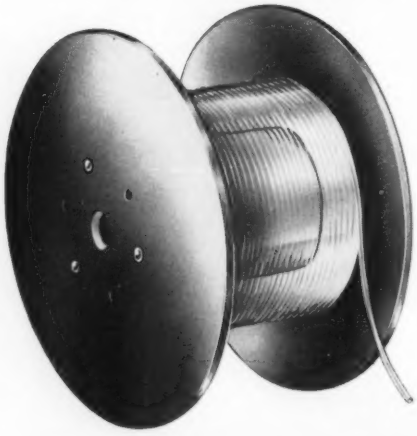
★ ★ ★

Information regarding the extent to which rods from continuously cast billets would already have proved better or cheaper than those obtained by orthodox rolling was not available to the authors of this paper. But here again a trend seems to be perceivable, which deserves attention from those who want to keep abreast with progress.

A REVOLUTIONARY NEW INEXPENSIVE

DISPOSABLE SPOOL

FOR WIRE PACKAGING



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MASONITE TEMPERED PRESDWOOD

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Sizes available
4 inch to 15 inch
Head sizes with any
barrel diameter desired

Non-Loosening Bolt Assembly

•

Durably constructed to absorb an excessive amount of punishment regardless of the shipping mileage problem and plant usage.

This unit has eight advantages for users of disposable spools:

1. Initial cost considerably lower
2. Disposable spools are approximately 1/5 weight of steel spools
3. Saving in freight charges for tare weight
4. No bookkeeping costs
5. No cost of handling and no storage space problem
6. No return freight charge for credit from user
7. No handling charge by wire manufacturer in receiving returned spools
8. No more reserve fund required by wire manufacturer for refunding

If you are faced with wire spool problem call, write, or wire us for immediate action.

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C. Dislocations

There is one word, now cherished: "dislocations." Here is how Wistreich, a steel research man, who is active also in the field of steel wire, thinks we might in future relate "rod appropriateness" with "keeping dislocations under control":

"The relative ease with which the shape of metal objects can be changed, the magnitude of the change that is possible without fracture, and even their characteristic tendency to work-harden, are all caused by irregularities in the atomic arrangement. Some of these crystal imperfections have been understood for a long time and have been put to practical use by metallurgists, particularly in the manufacture of alloys stronger than the solvent metals (e.g. the distortion of the crystal lattice by foreign atoms). The other kind of imperfection, the one which facilitates deformation by virtue of its dynamic character, had until recently existed only in the minds of mathematicians. But within the last few years the "dislocation," as this imperfection is called, has become a physical reality.

In the present state of research much remains to be learnt about dislocations before they can be brought under full control. But what is already known about them is of great interest and potential value to those concerned with wrought metal products. The yield strength of an ordinary crystal of tin is about 200 lb/sq. in.; that of a very thin tin whisker, which so far is the only known form of a crystal deficient in dislocations, is about 200.000 lb/sq. in. (And, by the way, as early as 1954 iron whiskers have been obtained, the tensile strength of which attained 1.900.000 p.s.i. (24)). The maximum elastic strain of a tin whisker is 3%, that of piano wire, which is the strongest form of wrought metal known, is only about .5%. Perhaps it may one day be possible to control the presence and behaviour of dislocations so that during shaping a metal is no stronger than the ordinary single crystal of tin, but that the final product may be endowed with the strength and elasticity of the tin whisker (23)."

★ ★ ★

This subject is one of some considerable difficulty, and it would not be inappropriate, we feel, to supplement the scientific wording of the printed text with a kind of illustration of the process by means of a visual comparison.

★ ★ ★

Any piece of steel contains a number of defined atomic "lattices," where the lines of atomic cohesion can be imagined as the criss-cross of pale blue lines on a piece of ruled paper.

★ ★ ★

Let us imagine that we cut out an oblique strip of such paper, so that successive squares are opposed, scissor-fashion, by their summits. Let us now assume that we "draw" this strip of pseudo-wire. Drawing will result in all squares being flattened into lozenges, the limit being two parallel lines blending into one another. Now this implies that the distance between two external and opposed summits is being decreased. All right, but there are forces at work —atomic cohesion—to oppose this flattening process.

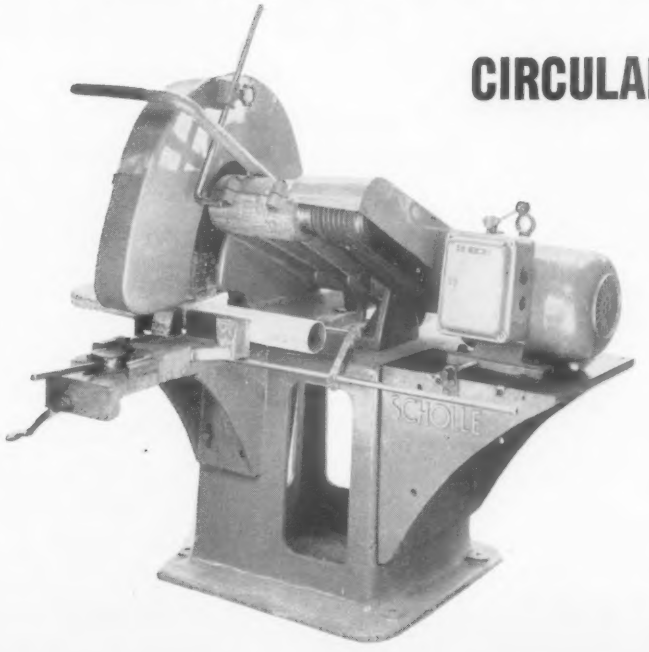
★ ★ ★

Such forces can conveniently be compared to telescopic dampers set at right angles to the direction of drawing and within each square. Now, there are two ways of dealing with the dampers: either you "dislocate" them, and you have easy drawing, or you block the telescopic pistons, and you have

PRECISION HIGH-PRODUCTION ABRASIVE WHEELS

or

CIRCULAR SAW BLADES CUTTER



Made for all kinds, even the hardest material, up to 3¼" diameter solid metals and up to 5" diameter through pipes or profile steel.

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high-tensile steel.

★ ★ ★

This will do to remind us, at the end of this paper, of the fact that in striving towards more appropriate rods in order to be able to produce more appropriate wire, there are no limitations and no ultimate achievements. As we are progressing, further aims, not distinguishable at first sight, show up. In our progression, therefore, no such thing as a rest, or even a short standstill or a slow-down is to be foreseen, because there is still a long way to cover before we get, not at, but near enough to the heart of the matter.

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Newly Developed Modern *High Speed*

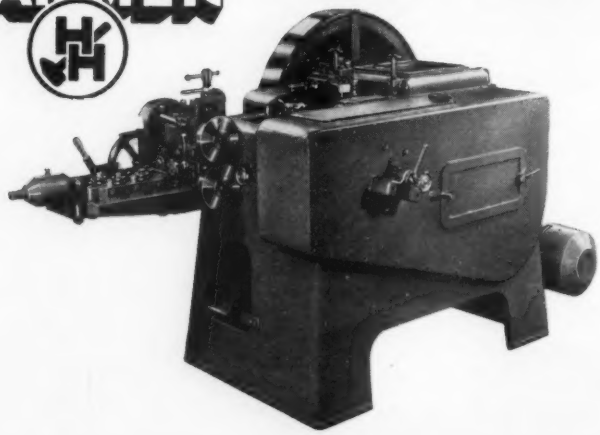
HEUER HAMMER

Double-Stroke **COLD HEADER**

for

BOLTS and NUTS

HEUER-HAMMER SYSTEM



All moving parts run in oil bath housing, protecting them from dust, dirt and shavings.

Noiseless • Smooth Running
Minimum Wear • High Capacity • Long Life.

Please ask for description and quotation.

Sole Representative:

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Patents

(*Continued from page* 1261)

No. 2,802,589, STACKABLE CARRYING CASE, patented August 13, 1957 by Elmer Charles Voigt, Chicago, Illinois.

A stackable wire-work carrying case particularly adapted for carrying containers of paper and the like is disclosed, with sides, ends and bottom of wire.

★ ★ ★

No. 2,802,897, INSULATED ELECTRICAL CONDUCTORS, patented August 13, 1957 by Dallas T. Hurd, Burnt Hills and Edith M. Boldebuck, Schenectady, N. Y., assignors to General Electric Company, a corporation of New York.

A combination is disclosed of a copper wire conductor, an insulating sheath consisting of a heat-converted synthetic resin which is deleteriously affected by copper at elevated temperatures and a shielding film of nickel interposed between the wire and the resin sheath; this nickel film having a frosted surface structure whereby adherence of such nickel to the contiguous surfaces of the wire and the sheath is promoted.

★ ★ ★

No. Re. 24,345, SPRING COILING MACHINE, patented August 20, 1957 by Charles R. Bergevin, Torrington, Conn., assignor to The Torrington Manufacturing Company, Torrington, Conn., a corporation of Connecticut.

There are twenty-three claims to the machine whereby wire is coiled to form at least one spring during each cycle and the spring is cut off at the end of the cycle.

★ ★ ★

No. 2,803,020, UPHOLSTERY SPRING ASSEMBLIES, patented August 20, 1957 by Vernon G. K. Walters, Northallerton, England.

A tie wire for a spring assembly is disclosed including a number of lateral loops, each comprising two legs and a central connecting portion, each leg being formed into a helix.

★ ★ ★

No. 2,803,287, WIRE STRAIGHTENER, patented August 20, 1957 by David Earl Varner, Wichita, Kansas.

Rollers apply pressure on opposite sides of the wire to selectively deflect same and rolling engagement of the rollers with the wire during rotation of an elongated arbor body and longitudinal movement of the wire therethrough straightens the wire.

★ ★ ★

No. 2,803,383, WIRE HOLDER FOR PRESSURE-ACTUATED CANISTERS, patented August 20, 1957 by Benjamin Dickman and Max Dickman, Philadelphia, Pa.

An all wire handle or holder is provided, comprising a single length of wire.

You Are Invited To Join

THE WIRE ASSOCIATION

Send for booklet describing its activities and a membership application card.

453 Main St. Stamford, Conn.

Weighing Samples of Wire to Determine Accurately the Hole Size of Fine Gage Diamond Dies

(*Continued from page* 1220)

is needed because of its greater weight per length. (See Figure 2)

★ ★ ★

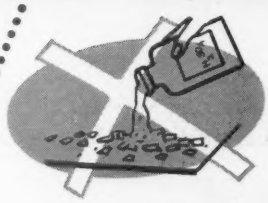
The actual wear of diamond dies in the wire drawing machines is checked (Figure 3) each day by the Wire Mill Inspection Organization. The inspector is provided with a measuring wheel and micrometer and obtains samples periodically from each wire drawing machine. The correct length is taken and placed in a marked envelope and the remaining wire is checked for roundness. These sample lengths are then weighed. By checking the finish die wear in this manner, the dies can be used until they approach very closely their limits for oversize wire.

★ ★ ★

The average diamond wire die size can be controlled by weighing measured lengths instead of with barrel micrometers. The precision

STANNOUS SULFATE . .

A PREPARED chemical of UNIFORM quality for LIQUOR FINISHING



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—Standard stock solutions are easily and quickly made up in advance . . . stannous sulfate composition is known, and is uniform from batch to batch.

ELIMINATES complex control

—there are only two simple ingredients to control . . . color adjustment is quick and simple and may be made immediately.

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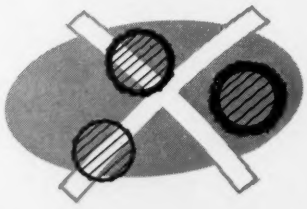
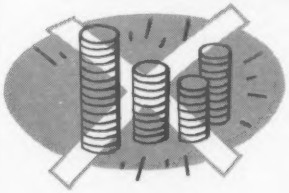
—tin content is divalent, the only form suited for iron replacement reaction . . . tin coatings are smooth and uniform, and of pre-determined thickness.





ELIMINATES unnecessary costs

—replaces needless processes, saves tin and copper, saves on time and labor, improves quality of tin coating.

Write for detailed information.

TIN & TIN CHEMICALS
CERAMIC MATERIALS
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HEAVY METAL SCRAP

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METAL & THERMIT—UNITED CHROMIUM OF CANADA LIMITED • REXDALE, ONT

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MANUFACTURERS OF WIRE • STRIP • BRAID • STRAND

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FINE WIRE

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IN THE FOLLOWING METALS AND ALLOYS

ALUMINUM- AND ALLOYS	MONEL-NICKEL	COPPERCOATED STEEL
BARE AND TINNED COPPER	STAINLESS STEEL	SILVER PLATED COPPER
LEAD AND SOLDER ALLOYS	STEEL-LOW AND HIGH CARBON	BRASS AND ALLOYS
PRECIOUS METALS	RESISTANCE WIRE	PHOSPHOR BRONZE

Exacting size tolerances—uniformity of tempers, a good product and prompt service. A dependable supplier soliciting your business.

Consultation—Samples and Quotations Without Obligation.

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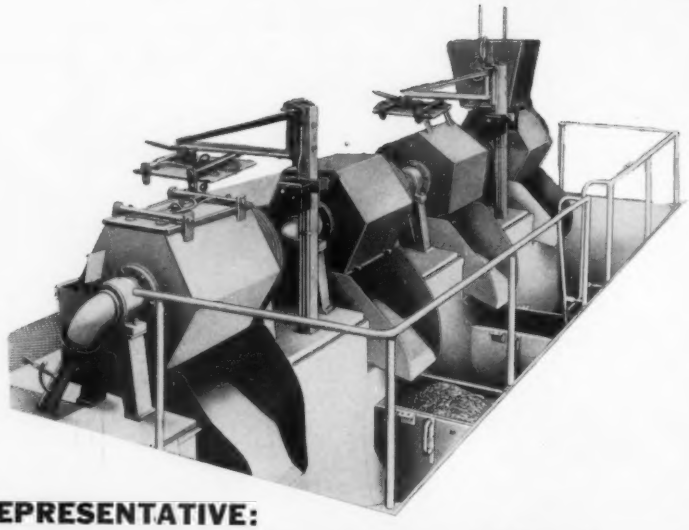
"AMNI" WIRE NAIL DRUMS



Are equipped with provision for sawdust extraction and for separation of point scrap.

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FIGURE IV

DIAMOND DIE SIZE SPECIFICATIONS

Gage No.	Wire Diam. Limits - Inches Min.	Nom.	Max.	Length or Turns of Sample	Sample Weight - Milligrams Min.	Nom.	Max.
36	.00495	.00500	.00505	8	538.3	549.3	560.3
36	"	"	"	4	269.2	274.6	280.2
37	.00445	.00450	.00455	10	543.8	556.1	568.5
37	"	"	"	5	271.9	278.1	284.3
37-1/2	.00425	.00420	.00425	5	236.5	242.2	248.0
38	.00395	.00400	.00405	5	214.2	219.7	225.2
39	.00345	.00350	.00355	7	228.8	235.5	242.2
40	.00305	.00310	.00315	9	233.7	237.5	249.1
41	.00275	.00280	.00285	10	207.6	215.3	223.0
42	.00245	.00250	.00255	10	164.8	171.6	178.5
43	.00215	.00220	.00225	10	126.9	132.9	139.0
44	.00195	.00200	.00205	10	104.4	109.8	115.4

Fig. 4—Each gage size is listed on the master chart together with the maximum nominal and minimum wire diameters and weights. * * *

torsion balances used at Tonawanda are delicate but with reasonable care, they require little maintenance. They are for all practical considerations free of wear. The Die Shop wire sampling machines are simple and inexpensive. Accuracy with the precision balances is within 0.2 milligrams or 15 millionths of an inch in measuring the diameter of 39 gage (0.0035") wire. Weighing wire samples has increased die life. The accuracy of this method has provided a tool that allows closer resizing of the dies. It is therefore possible to start the dies closer to their minimum allowable size, and gain the advantage of greater die life by continuing their use to near the maximum diameter.

Furnaces for the Heat Treatment of Wire

(*Continued from page* 1239)

for patenting is shown in Figure 21. The low voltage power transformers are located along the sides of the quench. Note the insulating cover used to minimize heat radiation from the surface of the salt.

★ ★ ★

Oil tempering in strand operation is also common practice in the wire mill. Pretempered wire has many applications and offers the spring manufacturer and other users a material with exceptionally high physical properties. It is ready for coiling or forming, and requires only a low temperature stress relieving heat treatment on the finished spring or wire form. Strand oil tempering furnaces are usually of the tube type, electrically heated or fuel fired, with or without prepared atmosphere, although some practices utilize lead or salt as a heating media. Quenching to maximum hardness is commonly done in recirculating oil and the fully hardened wire is drawn back to the required hardness in a lead bath.

★ ★ ★

There are numerous other types and designs of furnaces for the heat treatment of wire in coils and strands in use today. Many developments and improvements in design and construction have been made in the past decade and many more are apt to come. The wire manufacturer must produce wire to meet specifications at minimum cost, and looks to the supplier of industrial furnaces for low cost, efficient, economical, and trouble-free heat treating equipment to produce the desired results.

★ ★ ★

Considerable progress has been made in materials for use in furnace construction. Improved alloys, refractories, and other materials,

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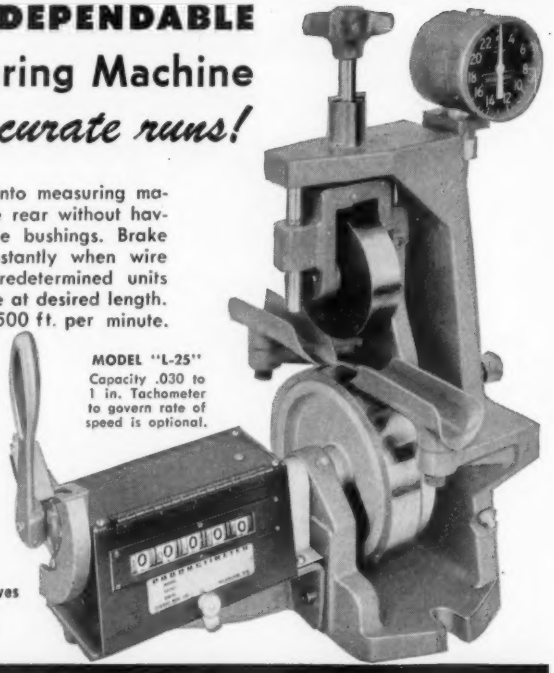

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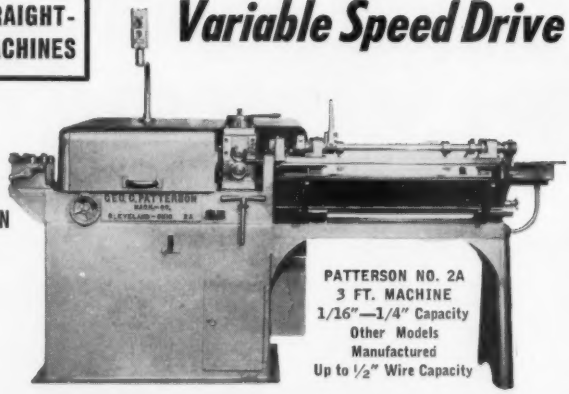

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new instrumentation, controls and mechanical components give the furnace designer of today many advantages. The trend in furnace designs today is for more versatility, wider ranges of operating temperatures, higher efficiencies, and low overall cost of operation.

★ ★ ★

Developments have been made in refractories to give efficient, low cost, low heat loss composite refractory installations. Combustion equipment has been developed to meet very critical conditions and requirements. Compact, high temperature recirculating fans, which eliminate external duct work and chambers are available, making it possible for the furnace designer to utilize these to advantage.

★ ★ ★

There is a definite trend to automatic furnace operation, wherever possible. Exacting furnace heating, quenching and cooling cycles can thus be easily maintained and are not dependent on the attention, ability, or conscientiousness of the operator. Continuous furnaces are being designed to operate at high thermal heads efficiently, making it possible to utilize higher heating rates, and effect savings in floor space.

★ ★ ★

Developments are being made in both electrical resistance heating, and induction heating methods which look very promising for strand heat treating applications. Double salt patenting, that is, heating in a salt bath and subsequently quenching in another salt bath in continuous strand operation, is being investigated. There is a demand for versatile, combination type of furnace equipment capable of handling a number of heat treating operations.

★ ★ ★

We can expect many new developments in wire heat treating furnaces and practices during the next few years. The industrial furnace industry is constantly striving to produce equipment designed for improved product quality and low cost operation.

Grateful acknowlegment is made to the following organizations for their cooperation in furnishing illustrations and information for the preparation of this presentation:

Surface Combustion Corporation, Toledo, Ohio
Lee Wilson Engineering Company, Cleveland, Ohio
American Gas Furnace Company, Elizabeth, New Jersey
The Drever Company, Philadelphia, Pennsylvania
Harper Electric Furnace Corporation, Buffalo, New York
Gas Machinery Company, Cleveland, Ohio
Ajax Electric Company, Philadelphia, Pennsylvania
A. F. Holden Company, Detroit, Michigan
Bellis Heat Treating Company, Branford, Connecticut

Comparison of Gas and Electric Strand Annealing Furnaces

(*Continued from page* 1187)

plotted as a function of load (weight of wire annealed per day), the following curves are obtained. It is obvious that at any given load the electric furnace is much more efficient than the gas.

Initial Cost

The electric furnace with all its associated equipment costs about 50% more than a comparable gas furnace. An approximate value for the ten foot furnaces described in this report would be fifteen thousand dollars ($15,000.00) for electric and ten thousand dollars ($10,000.00) for gas.

Daily Operating Costs

When considering daily operating costs, there are other charges which must be added to the fuel costs. For the electric furnace demand **charges** of seventy-three cents ($.73) a day have to be added to kilowatt hour cost.

★ ★ ★

Air has to be supplied to the gas furnace to support combustion. Secondary air is also drawn into furnace hood, along with the products of combustion, and the mixture is exhausted by a blower. The cost of operating the blower and heating this volume of air

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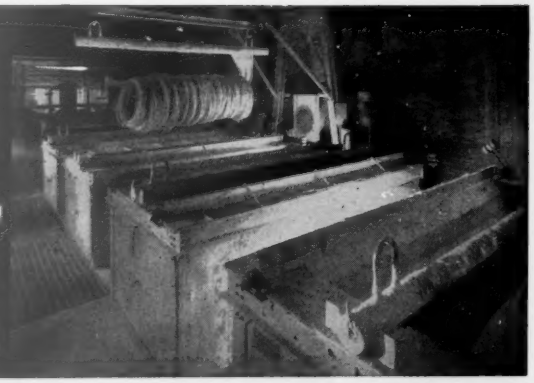

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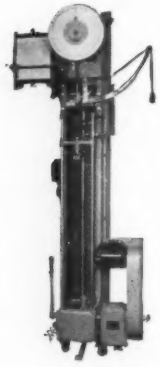

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from out-door to room temperature in the winter time is charged to the gas furnace at the average rate of ninety-five cents ($.95) per day. The heating season is taken as six months long and on the average the air is heated 30°F.

★ ★ ★

A tabulation, in bar graph form, of daily operating costs of the two furnaces is included for comparative purposes. (Figure 7)

Maintenance Costs

When discussing maintenance costs, there are again factors which are common to both furnaces such as Inconel tube replacement and rebricking. The following items are relevant only to a particular furnace, i. e.: burner, mixing apparatus and air handling gear repairs and upkeep for the gas, and resistance heating element replacement for the electric furnace.

★ ★ ★

Inconel tube life is much longer in the electric furnace than in the gas furnace. Tubes are changed on the average about every six months in gas furnaces and the tubes now in place in the electric furnace have been in use for over five years.

★ ★ ★

The shorter tube life in the gas furnace is probably due to the way the tubes are heated. Although the temperature of the furnace is considered 1750°F, the temperature is not distributed evenly and there is considerable variation along the tube length. If the flame actually touches the tube at a spot or comes close to it, the temperature far exceeds, at this local point, 1750°F and may approach the critical temperature of the Inconel. The erosion and corrosion caused by products of combustion also hasten the deterioration of the tube.

★ ★ ★

None of these detrimental factors are present in the electric furnace. There are no products of combustion and the temperature is much more evenly distributed

hence, the longer tube life. For this study, tube life of the electric unit was considered two years, although it is actually much longer.

★ ★ ★

The lack of a flame and products of combustion increase the refractory life in the electric furnace and therefore makes its maintenance cost less than that of the gas furnace. Our ten foot electric furnace has been in operation five years and has never been rebricked or repaired.

★ ★ ★

The gas furnaces must be rebricked approximately every two to two and one-half years. Again, the greater variation in temperature throughout the furnace, flame and gas impingement and corrosive action of the products of combustion all tend to shorten the refractory life of the gas furnace.

★ ★ ★

The cost of maintaining the burners, mixing and air handling equipment for the gas furnace is small compared to the other upkeep figures. Whereas, the cost of changing the Tophet A heating element for the electric furnace is considerable. It is estimated that the normal life of the element is five years, although in this case, the ribbon has been in continuous use for more than five years.

★ ★ ★

Comparative costs of maintaining the two furnaces have been summarized on a yearly basis and are included in the following chart.

MAINTENANCE COSTS/YEAR

	Electric	Gas
Refractory Upkeep	$ 300.00	$ 600.00
Tube Replacement	500.00	2,000.00
Tophet A Ribbon	400.00	—
Burners, Air Handling, etc.	—	100.00
	$1,200.00	$2,700.00

Ambient Conditions

Other factors, not discussed previously, are the intangible assets of utilizing electric furnaces (the increase in comfort and live-ability in the area). One of these would be the elimination of primary air to support combustion, and secondary air which is drawn into the

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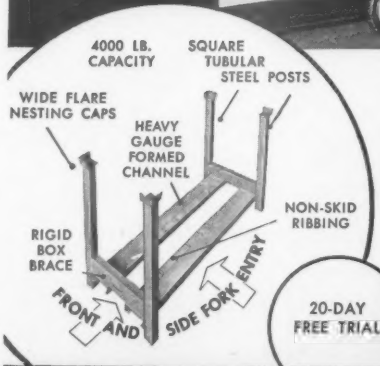

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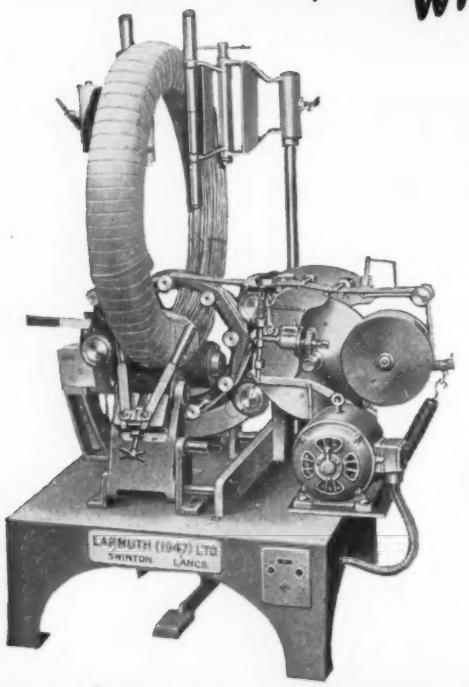

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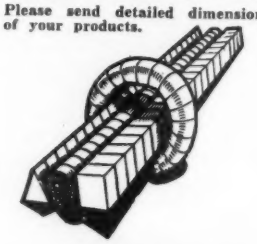

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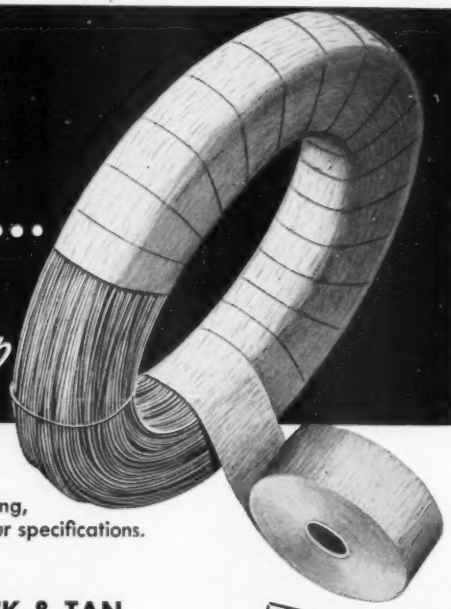

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stack. Without the need for this air, a better degree of control is obtained in the winter for heating purposes and in the summer for ventilation. Any air then supplied in this area then can be directed for the above purposes, rather than be consumed by the gas furnaces.

★ ★ ★

Another gain is the reduction of the heat lost to the room when the gas furnaces are replaced. For the ten foot furnaces, the gas loses three times as much heat, by radiation conduction, convection and gas seepage, as does the electric. The difference in heat lost is sufficient to warm at least three average size one family homes for an equal period of time. The removal of this heat source would be most appreciated in the summer time.

Conclusion

1. The electric furnace costs more initially, but is cheaper to operate and maintain than the gas furnace. The following table summarizes these factors:

	Electric	Gas
Yearly Operating Cost	$1,200.00	$2,445.00
Maintenance Cost	1,200.00	2,700.00
Depreciation	1,000.00	670.00
	$3,400.00	$5,815.00

★ ★ ★

a) The original costs of the furnaces have been depreciated over a period of fifteen years. Yearly operating costs are based on the actual fuel costs averaged by furnaces during the test period.

★ ★ ★

Assuming both furnaces operated continuously at full load and adjusting fuel costs, the following table is obtained:

	Electric	Gas
Yearly Operating Cost	$1,630.00	$2,745.00
Maintenance Cost	1,200.00	2,700.00
Depreciation	1,000.00	670.00
	$3,830.00	$6,115.00

★ ★ ★

In both instances it is decidedly cheaper to use the Electric Furnace for Strand Annealing Alloy wire or strip. Although not specifically shown in this report, the

savings made by utilizing electric furnaces would hold true with only a slight variance for any operating temperatures between 1400°F and 2200°F.

★ ★ ★

2. The plant maintenance problems are eased when an electric furnace is used, because less actual time is spent on maintaining this unit than if it were a gas furnace.

★ ★ ★

3. The problem of heating and ventilating the building which houses this furnace is simplified when an electric furnace is used.

★ ★ ★

4. Employee morale is improved with the selection of an electric furnace because the work area is much more comfortable than it would be with a gas furnace.

★ ★ ★

The reader is reminded of the special conditions, as set forth in discussion, which govern this study. If, in comparing any other two furnaces, the usages are different or there is a substantial variation in any of the previously mentioned conditons, then an entirely new analysis would have to be made to determine which type would be cheaper or more efficient. But, when selecting a furnace for strand annealing which substantially meets the set conditions, an electric furnace is a superior choice.

Weaving of Aluminum Insect Screening

(*Continued from page* 1235)

of the cloth. These "flat" surfaces naturally tend to reflect light much differently than the round wires, thereby, causing the wire to have an uneven appearance; sometimes a pattern effect, instead of the smooth, even sheen desired by the customer.

★ ★ ★

In this age of automation and high speed production, it is some times a frustrating thought that insect screen cloth weaving looms are not weaving any appreciable amount faster than they were 50 or more years ago. There are several high speed looms in the experimental stage, but to date they have been unable to produce

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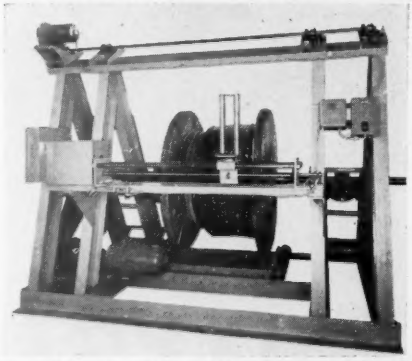

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the high quality cloth produced by the slower looms. Aluminum insect screen cloth is produced at the rate of 15 to 22 feet per hour per loom, depending on the width of the cloth being woven. Due to this low rate of production, it is necessary for weaving companies to operate a large number of looms. The larger Companies operating from 300 to 500 looms. This low rate of production per loom is partially overcome by the fact that an experienced man or woman can operate a set of from 8 to 16 looms. In order to make this practical, the looms are set up in double rows as shown in Figure 3. An operator has 4 to 8 looms on each side of the aisle.

★ ★ ★

Although the looms have had few improvements to increase production, many of the related operations have been modernized, thus assisting in minimizing the cost of the screening to the home owner. In the rod and wire mills, automation and high speed equipment have been able to reduce the cost of weaving wire nearly enough to meet the increased cost of the weaving. Aluminum fine wire is now drawn at the rate of 5000 feet, or more, per minute in most mills.

★ ★ ★

A few years ago all the weaving mills had large batteries of bobbin winding machines, employing many people to keep the looms supplied with bobbins. Today most of the mills have installed motorized single unit bobbin winders at each loom, and the loom operator now winds his own supply of bobbins, thus reducing overhead and simplifying the operation which has also resulted in increased production and smoother flow of materials.

★ ★ ★

The weaving industry and its suppliers have done much in recent years to improve the Aluminum insect screen cloth product, to meet the eye appeal and protection of the public, but it is a very reasonable supposition that the Aluminum screen cloth which adorns your homes today was woven on the very same looms as the screening on your grandfather's house.

The History of and New Developments in Wire Packaging

(*Continued from page* 1223)

penditures. The larger user of wire felt that these changes in procedure, even though costly, could be justified by the fact that they could increase their running time with the heavier package and, in some cases, operations could be speeded up and, above all, they had eliminated the deposit factor which, in itself, to some users involved quite a sizable sum of money. To the smaller user, he was faced with a real problem. First of all, he was forced to carry heavier inventories than he did in the past because, in a good many instances, he purchased packages only large enough to meet his immediate needs. To the user whose operation entailed the use of several sizes of wire this problem of carrying heavy inventories because the smaller package of wire was practically eliminated was a drastic problem, and, in addition, the smaller user could not justify the expense of making changes in his equipment.

★ ★ ★

These problems of the users became the problem of the wire maker who, in addition, had problems of his own in having to change his entire plant procedures as well as spend sizable sums of money on new equipment to accommodate the packaging of wire in drum containers. The wire maker found himself in the middle between the larger user and the small user and, in addition, wire makers found themselves in a terrific competitive position where one producer was trying to out-do the other in packaging various types and sizes of wire in drum containers to put theemselves in a better competitive position with the larger users. From the wire maker's viewpoint all realized that the users would be more and more demanding that all types of wire that were being packaged in returnable containers would ultimately have to be put up in either a no-deposit or a non-returnable container.

★ ★ ★

Facing this problem, the wire makers concluded that while drum

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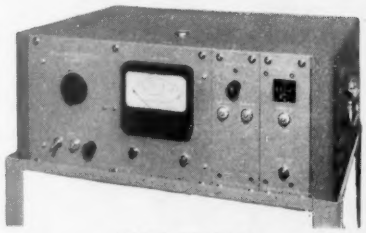

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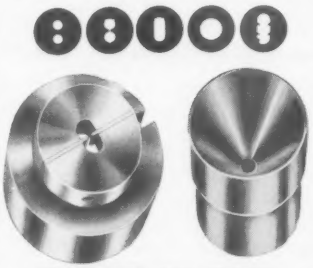

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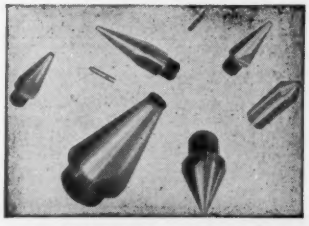

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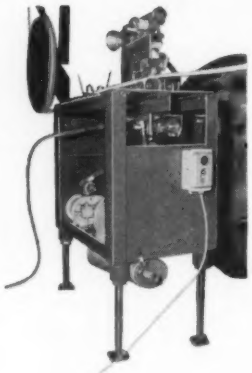

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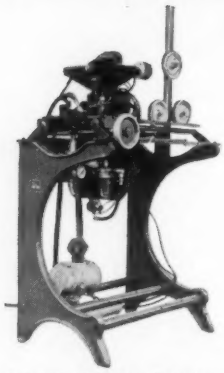

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packaging definitely had its place and would undoubtedly be considered as an accepted method of packaging, other methods of packaging must be devised to take care of the needs of the small user and, by like token, supplement the drum wherever possible so as to come up with a method of packaging that would be adaptable to their present equipment involving a minimum amount of expense for equipment change-over. This is to the user's advantage as well as to the wire maker's.

★ ★ ★

To accomplish this end meant only one approach and that was through the principles of spooling. Considerable thought and research were devoted to this problem from within the entire industry which led to the adoption by the leading suppliers of tire bead wire of a package whereby better than 1000 pounds of wire could be packaged and shipped on a disposable fibre core which cost between 60 and 70 cents and weighed less than five pounds. This method of packaging was accomplished by the combined efforts of the producers of tire bead wire and an established spool and reel manufacturer who collaborated to refine a method and procedure of packaging, the basic ideal of which came from Mr. Bob Pierce, now deceased, who was vice president in charge of engineering at National Standard Co.

★ ★ ★

This entire development was carried through with the determination that it would be adaptable to the equipment which was presently being used in both the wire makers' and the wire users' plants. This has been accomplished and the manufacturers of tire bead wire have adopted this method of packaging as a standard. This method of packaging has been used by some of the leading manufacturers of tire bead wire for approximately two years and within that time the same principle of packaging has been used for packaging other types of wire. The process is simple and involves the following procedures.

★ ★ ★

For mill operation a fully ma-

chined aluminum take-up reel with a demountable head is used. This reel is designed to be used with the standard take-up equipment which is used by the majority of the wire makers in their operations. The 1,000 pound capacity bundle is packaged on a reel which has a 30" head diameter, 11" traverse, and takes a removable Kraft paper core having a 14" inside diameter by 14¾ outside diameter. This core is mounted on to the reel and the demountable head is then assembled. These reels are all aluminum and weigh, when assembled, roughly 100 pounds. Wire is then wound on the reel at the same speed and tension as used for normal operation. When the reel is loaded the bundle of wire is wrapped tight with steel strapping. There are six slots in the flange of the reel which permit drawing the steel straps tight. At this point the demountable head is removed and the straps hold the bundle tight without shifting or loosening. The package can then be wrapped with a tear string paper wrapping or, in some instances, these bundles are wrapped with waterproof paper. The bundles are then placed on skids and it is the usual practice to ship two 1,000 pound bundles per skid.

★ ★ ★

The entire cost of this package, including the skid, the steel strapping, and the paper core, is roughly $2 per thousand pound package.

★ ★ ★

With this method of packaging the problem of handling these large bundles of wire became evident and a clever lifting mechanism has been developed to lift and maneuver these heavy bundles easily and swiftly. This lifter can be used in connection with any type of hoist. It consists of an arched aluminum track perfectly balanced so that the coil can be changed to any angle or position desired. The actual contact portion is a heavy rubber bag which is inserted in the core and when blown up with air pressure provides ample friction grip to hold the coil firm. The coils can be moved anywhere you want and quickly released by the operation of an air valve. This

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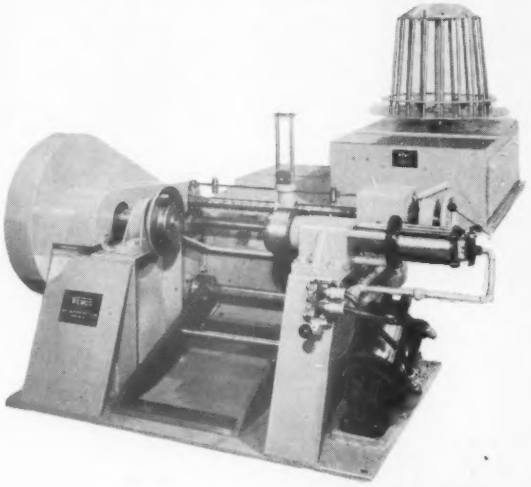

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lifter and tilter has provided a means of easy handling and palletizing these large coils of wire and it is so simple that even a girl can perform this operation.

★ ★ ★

At the point where the wire is consumed a let-off reel is provided. This reel also has a demountable flange and is of all aluminum construction. The weight of the let-off reel is approximately 120 pounds. The coil is assembled to the reel and when the demountable head of the reel is assembled, it is drawn against the wire under constant tension which eliminates wire dropping and trapping. The sides of the wire are under tension at all times as the wire is being removed from the reel. This method of holding the sides of the wire under tension is accomplished by two methods.

★ ★ ★

One method is offered which consists of a patented air bag arrangement which, when the bag is inflated, holds the two reel heads under tension. The other method of accomplishing this tension arrangement is by means of springs. Both types of tensions devices have proven extremely successful. Once the reel heads are assembled to the bundle of wire, the strapping is cut loose and the wire is ready to take off. These take-off reels are designed so that they are adaptable to the standard take-off stand which the average wire user has been using in his plant over a period of years. The big advantages of this type of packaging are that there are no reels to be returned, no freight costs, and no maintenance costs whatsoever. This method of packaging has eliminated the necessity of shipping wire on reels that weigh anywhere from 100 to 250 pounds of dead weight which means that the wire manufacturer is shipping wire and not reels and eliminates the freight costs on returning the empty reels to the wire maker.

★ ★ ★

If this method of packaging has no other advantage than the freight savings involved it would pay its way several times every year. But

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there are other advantages equally startling. For example:

(1) It is not necessary to rewind wire from these packages which in some instances in the past a wire user was forced to do, especially in the case of wire being used for stranding operations such as is used for ACSR cable reinforcing wire.

(2) It is possible to anneal wire on these big packages without using reels which means an increase in the efficiency of annealing equipment by not having to heat heavy steel reels which involves considerable dead weight as referred to previously.

(3) The initial cost of this equipment is reasonable.

(4) There are no radical changes needed to present equipment in the plant or the wire maker or the plant of the wire user.

(5) There are no new skills needed to package wire by this new reel-less package method.

★ ★ ★

Along with this development came the clever handling mechanism referred to and, in addition, there have been, since this method of packaging was introduced, new applications and uses for this type of package on types of wire that heretofore has been shipped in bundles which involved considerable cost to both the wire maker and wire user. In the past there has been wire that has been shipped in bundles which necessitated reeling on the part of the user. The wire maker is able to furnish his customer with wire which does not require the additional cost of reeling at the user's plant. A good example is galvanized ACSR reinforcing wire. This wire, for many years, has been shipped in bundles and the processor of this type of wire was forced to wind this wire on a reel before being able to process this wire through his stranders.

★ ★ ★

Today there are manufacturers of ACSR reinforcing wire who are shipping wire by this new method of packaging whereby the user need only assemble his package to one of the aluminum take-off reels referred to previously and this package is ready for processing in his stranders. In addition, the wire maker can supply his customer with packages of wire on which the exact footage in the bundle can be determined. This is a terrific

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The Standard of the Wire Industry

advantage to the wire user because in his stranding operations he is able to match up his coils which eliminates considerable loss in waste. This method of packaging cable reinforcing wire is in its infancy and is a method of packaging which is rapidly becoming popular from both the wire maker's as well as the wire user's standpoint.

★ ★ ★

Along with this method of packaging, a machine has been developed for use in the wire maker's plant to handle the spooling of reinforcing wire and this equipment is so set up that bundles of predetermined footages can be packaged, or if it is not necessary to furnish a bundle of pre-determined footage, the exact footage of wire being packaged is recorded and can become part of the information on the shipping tag with the packaged wire.

★ ★ ★

In addition to the two applications which have been referred to and explained in some detail there are countless other types of wire which are being packaged or are being considered to be packaged by this method. The method has proven itself extremely popular because of the comparative reasonable initial cost of equipment and the fact that it is possible to package wire whereby the packaging costs are infinitesimal as compared to the volume of wire being shipped.

★ ★ ★

Up to the present time there has been equipment developed to handle two sizes of packages—the 1,000 pound package referred to and a package which ranges between 500 and 600 pounds depending upon the type of wire being packaged. We gave you the dimensions of the 1,000 pound package. The smaller package is put up on reel equipment which has a 22" flange diameter, is furnished with either a 10" or 11" traverse, and is made to accommodate a removable Kraft paper core which has an 11" O.D. by 10½" I.D. These cores cost approximately 40 cents each.

★ ★ ★

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instances that it is possible to package wire without the use of the paper core. Using a take-up reel that has a removable head and a collapsible type of barrel, it is possible to make up satisfactory packages. The elimination of the paper core has added additional cost savings. This has been accomplished with no difficulty either within the plant of the wire maker or the plant of the wire user.

★ ★ ★

With reference to packages of wire which have been put up by eliminating the paper core, it has been found possible to package wire on a take-up reel, band it with steel strapping, and anneal the package of wire. This has introduced a considerable saving in some operations, especially in the non-ferrous field and especially in the packaging and processing of aluminum wire. Today, aluminum wire is being successfully drawn onto a take-up reel as referred to with a collapsible barrel, eliminating the paper core. The bundles of aluminum wire are being strapped with steel strapping and annealed and shipped. This has introduced a tremendous saving to the processors and users of this particular type of wire. The same principle has also been used with hard bronze and copper wire.

★ ★ ★

This method of packaging which has been described is about the newest development which has been introduced to accommodate the packaging of heavier gauges of wire on inexpensive non-returnable packages and it is the feeling that the surface, as far as the possibilities of this method of packaging, has not at all been scratched as daily there are more and more applications for this method of packaging being introduced throughout the wire industry.

★ ★ ★

Until the present time there has been no concerted effort to go into smaller sizes of packaging by this method, however, it is felt that it would be possible to go down into sizes of packages which would be less than 100 pounds capacity.

★ ★ ★

Along with this method of packaging, as new problems are being introduced in connection with adopting new uses for this package, an engineering service is available to both the wire maker and the wire user to assist them in adapting their present equipment to this method of packaging and if there are any special machines or special fixtures required an engineering service is available to work out the problems in question.

★ ★ ★

As far as the packaging of heavier gauges of wire is concerned, in both the ferrous and non-ferrous industry it has been pretty much established that the larger percentage of the users are interested in obtaining wire packaged in as large volume as is possible and practical. This trend has more or less established that the two types of packages previously discussed, namely the drum type package and the reel-less type of package, are adopted pretty much as standard.

★ ★ ★

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However, as far as the packaging of finer wires is concerned, which involves packages ranging up to 100 pounds, there seems to be tremendous confusion throughout the industry.

★ ★ ★

For packaging packages ranging between 75 and 100 pounds there has been a series of non-returnable reels introduced by the various manufacturers. These reels are constructed of what are termed inexpensive materials such as paper composition, compressed sawdust, wood and phenolic composition, and many other types of materials. Many of these so-called inexpensive reels have been introduced to the industry by small manufacturers who have no conception of the problems involved in packaging wire. As a result, a good many of these packages have come and gone and in some instances wire manufacturers have spent a considerable sum of money in an effort to try the various types of reels which have proven unsatisfactory.

★ ★ ★

As far as non-returnable or disposable reels are concerned, there is still a great deal of development and consideration which must be given to this matter. And, as a word of warning to the wire manufacturers, all of these so-called new developments and reels made of various compositions must be given careful consideration. The wire manufacturer must realize that until he finds a package whereby he can package his wire for a figure of approximately 1¼ cents per pound it is not practical for him at this stage to go all-out on a non-returnable type of package. There has, in the last few months, been packages introduced to the wire industry to accommodate packages of 5-10-20 pounds and considerable claims made as to the fact that these spools could be made cheaply enough to classify them as a non-returnable.

★ ★ ★

However, if the wire maker will analyze the construction of these spools and realize that they will not stand up under the pressures and rugged use that spools of wire are subjected to by both the wire maker and the wire user, he will soon realize that as of now there is no spool that has been introduced to accommodate the packaging of the finer gauges of wire that can be classified as a non-returnable. In the sizes of wire that is being packaged on these sizes of spools the cost of a good spool is infinitesimal as compared to the product. This factor should be remembered.

★ ★ ★

This is not true as far as the 100 pound package is concerned because there are reels available which will accommodate the packaging of wire on packages of between 80 and 100 pounds which will stand up and can be purchased at a figure of less than $1.

★ ★ ★

To sum up this entire packaging situation, there is one thing all of

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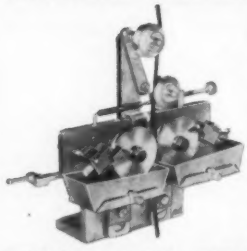

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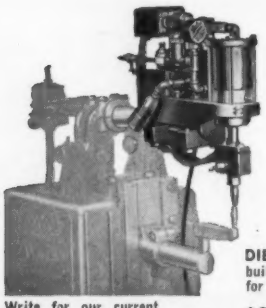

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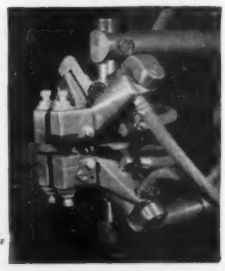

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us must realize and that is the day will never come when the conventional type of returnable spool or reel will be classified as obsolete. There will be conditions and types of wire which will have to be packaged on the conventional deposit type of reel or spool. The day, however, might come when the wire user might force the wire maker to ship wire on this type of package and eliminate the deposit. However, it is felt that this type of package will always have a place in the industry as will the drum and bucket type of package, the reel-less type of package, and the so-called non-returnable type of reel.

Plating Wire for Eye Appeal
Survey of Finishes and Processes

(*Continued from page* 1246)

providing very good resistance against the formation of red rust when plated on steel. Its two principal disadvantages are its toxicity and the fact that it forms rather voluminous and unsightly corrosion products after a period of time.

★ ★ ★

While the continuous electrogalvanizing of wire is performed with acid plating solutions, the production of decorative zinc coatings on wire products is accomplished with alkaline solutions of the cyanide type. The recommended concentrations cover quite a wide range but the basic ingredients are:

1. **Zinc cyanide**
2. **Sodium cyanide**
3. **Sodium hydroxide**

★ ★ ★

One or more proprietary addition agents are added to the basic solution for the production of bright deposits. In addition, it is customary to follow the plating operation with a bright dipping process. Initially, a ½% nitric acid solution was used but during recent years most zinc platers use proprietary dips which are based upon chromates or chromic acid plus other materials. These dips serve two purposes:

1. **Improved brightness**
2. **Inhibit formation of white corrosion products.**

★ ★ ★

In addition, some of them give a chrome-like appearance to the surface and this is frequently desired.

★ ★ ★

Zinc deposits have attained an important position where inexpensive, bright, corrosion resistant coatings are required and food toxicity is not involved.

Nickel-Chromium and Nickel-Brass

The use of bright nickel deposits on wire products is widespread. Nickel, however, is seldom used alone because it tends to tar-

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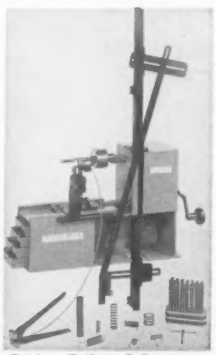
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nish, assuming a yellowish tinge, upon exposure to air. For this reason, it is overplated with chromium or brass, depending upon which appearance is desired.

★ ★ ★

Nickel forms an excellent base on wire products upon which the final coating may be plated for several reasons:

1. **Excellent corrosion resistance.**
2. **Bright deposits may be obtained from relatively thin coatings.**
3. **The deposits tend to cover welded areas very satisfactorily, providing brightness and freedom from porosity.**

★ ★ ★

The basic solution for almost all of the present day bright nickel processes is the Watts bath. The solution contains:

1. **Nickel sulfate**
2. **Nickel chloride**
3. **Boric acid**

★ ★ ★

This is an acid solution to which several proprietary materials are added in order to produce bright deposits which are free of pits.

★ ★ ★

A second basic solution which is finding some favor is the "high-chloride" bath. It contains the same basic ingredients but the amounts of nickel sulfate and nickel chloride in it are, roughly, reversed.

★ ★ ★

Chromium may be deposited directly on bright nickel to attain a hard, tarnish resistant, bright finish. Chromium provides excellent protection against many corrosive media found in the home and is widely used on wire products for this reason. The standard bath has been one containing chromic acid and sulfuric acid. During recent years, a number of proprietary baths have been introduced which offer advantages in speed of plating, throwing power, and ease of control.

★ ★ ★

Where a brass finish is desired, it may be plated over bright nickel. Brass is seldom plated directly on

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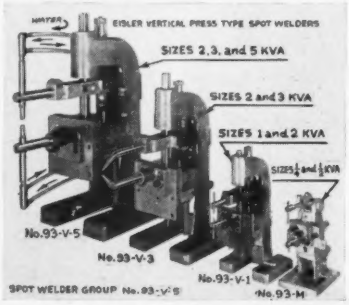

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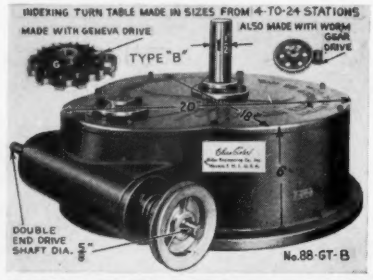
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steel because the rate of deposition is low and the brightness of thick deposits is seldom satisfactory. Therefore, as in the case of chromium, the brass deposits are quite thin and reflect the brightness of the underlying nickel. Brass solutions are of the alkaline cyanide type and contain:

1. Copper cyanide
2. Zinc cyanide
3. Sodium Cyanide
4. Sodium Carbonate
5. Sodium Hydroxide

★ ★ ★

Proprietary additives are available to promote brightness.

Bronze and Bronze-Brass

During the past several years, there has been a rapid increase in the use of bronze deposits on wire products. It should be understood that this bronze is a copper-tin alloy and is not the red brass which has frequently been incorrectly referred to as bronze.

★ ★ ★

Bronze deposits containing 10-15% tin have a very pleasing appearance with a true golden hue to them. They are not as yellow as brass deposits and the greenish tinge, which is common to brass, is completely lacking. Some users are marketing the bronze deposits as the final finish. In other cases where the brass appearance is desired, a thin coating of brass is applied over the bronze in the same manner as on nickel plated articles.

★ ★ ★

The use of bronze or bronze-brass offers several advantages over nickel-brass:

1. **Since the bronze solution has excellent throwing power and permits rapid deposition, bright deposits may be obtained in a very short plating time and on irregularly shaped articles. These deposits have good corrosion resistance and distribution of plated metal is excellent.**
2. **If bronze is used alone, only one deposit is required in place of two.**
3. **The use of bronze eliminates the use of more costly nickel.**
4. **Where bronze is used under brass, wearing through of the brass does not expose a metal with an entirely different appearance. Only**

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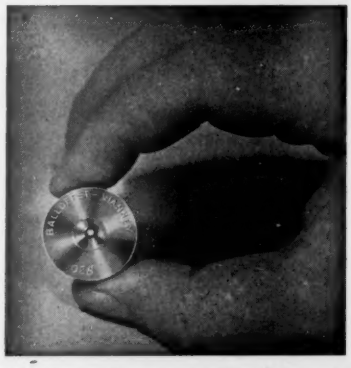

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close examination of worn spots will reveal that the brass deposit has been worn off.

★ ★ ★

There are two bronze solutions being offered by the plating industry at present. One of these is a proprietary solution involving the use of a pyrophosphate bath. The second process, which has been more widely adopted, contains the following standard chemicals:

1. Potassium stannate
2. Potassium hydroxide
3. Copper cyanide
4. Potassium cyanide

★ ★ ★

Proprietary materials for use in the solution to produce bright deposits are available.

Copper

While the volume of copper finished wire products has not reached that of brass, a considerable number of items are plated with copper as a final finish. Copper offers a reasonable degree of corrosion resistance and a warm, pleasing appearance.

★ ★ ★

Both acid and alkaline copper plating solutions are available but the alkaline baths are used for the plating of bright deposits on wire products. The solutions are based upon these standard chemicals:

Copper Cyanide
Sodium or Potassium Cyanide
Sodium or Potassium Hydroxide

★ ★ ★

The potassium salts are used where it is desired to obtain the maximum rates of deposition. Proprietary materials are added to the solution in order to obtain bright deposits, promote dissolving of the anode, and eliminate pitting.

Tin

The use of tin in the finishing of wire products for decorative appeal is both sizeable and steady due to the historical usage of this non-toxic metal in contact with food. The process of hot tinning has been the standard means of producing these coatings up to the last few years. In order to reduce the consumption of tin and produce coatings of consistent smoothness and thickness, electroplated finishes are becoming more widely used.

★ ★ ★

Of all of the commonly electroplated metals, tin is the only one that cannot be plated in a bright condition. In order to brighten it, a subsequent operation must be performed on the electro deposit. This is usually flow brightening which involves rapidly heating the tin to a point above its melting temperature of 451°F and quenching it. The surface then has the brightness which is normally associated with the tin can.

★ ★ ★

While both acid and alkaline tin plating solutions are available, the alkaline formulations are, by far, the more widely used outside of

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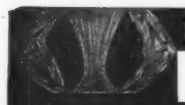
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* * *

The formulations used for alkaline tin plating are probably the simplest of any widely used plating solution. They consist of potassium stannate and potassium hydroxide, or sodium stannate and sodium hydroxide. The potassium baths are favored because they permit faster rates of deposition and are more chemically stable. No proprietary materials are required.

* * *

In conclusion, it may be stated that the manufacturer of wire products now has a wide variety of plated finishes from which he may choose. From these he may select one or more to meet his requirements with regard to eye appeal, cost and servicability. Similarly the plating engineer usually has a choice of processes to produce the desired finish at the lowest possible cost.

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Continuous Vulcanization of Butyl Insulated High Voltage Cable

(*Continued from page* 1192)

Results in Table 2 show that the inner surface next to the conductor exposed to the shortest cure at the lowest temperature (also see Figure 1) has the highest Tensile Strength and Elongation. Aging shows the reverse, the outside surface which is slightly overcured has better retention of physicals after the Air Pressure Heat Test.

★ ★ ★

Before the best possible overall balance of operating conditions and product properties can be established a thorough study is required.

★ ★ ★

Each cable manufacturer has his own Butyl based insulation. Electrical and physical properties of the product as well as the success of the Continuous Vulcanization operation are affected by formulation, handling, housekeeping, mixing procedure, temperatures of processing, degree of dispersion, uniformity of procedure, and production and technical supervision.

★ ★ ★

As far as the C.V. operation itself is concerned, one must consider specific machine and compound capabilities and limitations. The C.V. machine, the compound, or both may have to be re-designed or modified to give desired processing and properties.

★ ★ ★

The engineering principles applied to heat transfer and cure rate can be used to advantage to establish and control C.V. cures within limits. Care should be exercised to determine the effect of each variable on processing and properties. For example: What is the effect of increasing the thermal conductivity of the compound on cure time and electrical properties of the product? Or, what is the proper steam pressure to obtain the most satisfactory balance of properties in the shortest time?

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FURNACES—Galvanizing Equipment
Ajax Electric Company, Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Illinois
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Heat Treating
Ajax Electric Company, Philadelphia, Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Illinois
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Pot (Oil, Gas, Electric)
Ajax Electric Company, Philadelphia, Pa.
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Illinois

FURNACES—Resisting Heating, Strand
Electric Furnace Company, Salem, Ohio
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Illinois

FURNACES—Salt Bath
Ajax Electric Company, Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio

FURNACES—Strand Annealing
Electric Furnace Company, Salem, Ohio
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Illinois

GAUGES—Electronic, for Springs
Winstrom, Northampton, Mass.

GAUGES—Wire Diameter, Continuous
Industrial Gauges Corporation, West Englewood, N. J.

GALVANIZING EQUIPMENT—(See MACHINERY—Galvanizing Wire)

GEARMOTORS—
The Louis Allis Company, Milwaukee, Wisc.

GRINDERS—Roll
Norton Co., The, Worcester, Mass.

GUIDES—For Wire
Heany Industrial Ceramic Corp., New Haven, Conn.

GUIDE TIPS—For Extruding Machines (See NOZZLES)

HAMMERS—Nail Heading
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

HAMMERS—Swaging
Sjogren Tool and Machine Co., Auburn, Mass.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

INHIBITORS—Pickling
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

INKS—Printing, for Insulated Wire
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.

INSULATING MATERIALS—
Bakelite Company Div. of Union Carbon & Carbide Corp., New York. N. Y.
duPont de Nemours Co.. (Inc.), E. I., Polychemical Dept.. Wilmington, Delaware
General Electric Company, Alkanex Wire Enamel Dept., Schenectady, N. Y.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Plymouth Cordage Company, Plymouth, Mass.
Shawinigan Resins Corporation, Springfield, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, New York, N. Y.

INSULATING MATERIALS—Paper (For Electric Wire Cable)
Plymouth Cordage Company, Plymouth, Mass.

LACQUERING SYSTEMS—See MACH.—Lacquering Electric Wire

LAME—LAHN—
Montgomery Co., The, Windsor Locks, Conn.

LIME—
Warner Co., The. Philadelphia and Bellefonte, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N.Y.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Company, Harrison, N. J.
Rome Soap Mfg. Co., Rome, N. Y.
Standard Industrial Compounds Co., Frankfort, Ill.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUBRICANTS—Wire Rope
Swift & Co., Chicago, Ill.

MACHINERY—Armoring (Cable, Wire, Hose)
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Barbed Wire
Glader Wm., Machine Works, Chicago, Ill.
Wafios, Maschinenfabrik, Reutlingen, Wurtt, Germany

MACHINERY—Bobbin Winders
Cedar West Tool Company, Inc., New York, N. Y.

MACHINERY—Braiding
New England Butt Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bunching
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bundling, Scrap
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Capstans (See Capstans and Machinery—Winding Wire)

MACHINERY—Centerless Grinding & Polishing
American Laubscher Corporation, New York, N. Y.

MACHINERY—Chain Making
Nilson, A. H. Machine Co., Shelton, Conn.
Wafios Maschinenfabrik, Reutlingen, Wurtt, Germany

MACHINERY—Closing Rope
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coiling Rod
Vaughn Mach'y Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Cold Heading
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Copper Wire Drawing
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Herborn, Maschinenfabrik, Herborn, Germany
Morgardshammer Mek Verstads A. B., Morgardshammer, Sweden.
National Mach'y Exch (Used), New York
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire (See MACHINERY—Insulating Wire)

MACHINERY—Cutting
Eisler Engineering Company, Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.
Patterson Machine, Geo. C., Co., Cleveland, Ohio

MACHINERY—Descaling Rod, Dry
Fisher Associates, New York, N. Y.
Herborn, Maschinenfabrik, Herborn, Germany

MACHINERY—Die Making
Boulin, Victor J., Inc., New York, N. Y.
Dykrex Corp., Roos Tool & Mfg. Div., Newark, N. J.
Firth Sterling, Inc., Pittsburgh, Pa.
Metallurgical Products Dept. of General Electric Co., Detroit
Wayne Wire Die Co., Hillside, N. J.

MACHINERY—Draw Benches
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Edging (See MACHINERY — Tandem Rolling and Edging Mills)

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven, Company, Detroit, Mich.

MACHINERY—Extruding
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

Royle, John, & Sons, Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.

MACHINERY—Flat Wire
Mettler Machine Tool, Inc., New Haven, Conn.
Steel Equipment Company, Cleveland, Ohio
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Forming Wire
Nilson, A. H. Machine Co., Shelton, Conn.
Wafios Maschinenfabrik, Reutlingen, Wurtt, Germany

MACHINERY—Galvanizing Wire
Vaughn Machinery Co., Cuyahoga Falls, O.
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Gang Winders
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Mfg. Co., Wallingford, Conn.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Hydraulic
Manco Mfg. Co., Bradley, Illinois

MACHINERY—Insulating Wire
American Insulating Mach'y Co., Phila., Pa.
Beard Machine Co., York, Pa.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.
New England Butt Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Labeling Electric Wire
Dewyer, Inc., Libertyville, Ill.

MACHINERY—Lacquering Electric Wire
American Insulating Mach'y Co., Philadelphia
Cook Mfg. Co., The, Paterson, N. J.
Industrial Ovens, Inc., Cleveland, O.
Michigan Oven Company, Detroit, Mich.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Looms, Wire Weaving
Cedar West Tool Company, Inc., New York, N. Y.
E. V. G., Richard Kleinhans, New York, N. Y.
Maschinen & Stahl A. G., c/o Richard Kleinhans, Zurich, Switzerland
Wafios Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Material Handling
(See Material Handling Equipment)

MACHINERY—Measuring Wire & Cable
Durant Mfg Co., Milwaukee, Wis.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
New England Butt Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N. Y.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Packaging Wire
Coulter & McKenzie Machine Co., Bridgeport, Conn.

MACHINERY—Plating
Hodge Bros. Machine Shop, Ossining, N. Y.
Universal Industrial Equipment Co., Secaucus, N. J.

MACHINERY—Pointing
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York,
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Polishing Asbestos Wire
Beard Machine Co., York, Pa.

MACHINERY—Printing on Electric Wire
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M. Co., Inc., Boylston, Mass.

MACHINERY—Re-Spooling
Bartell Machine-Tool Corporation, Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Emory Company, Robert J., Newark, N. J.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
Industrial Winding Machinery Co., New York, N. Y.
National Mach'y Exch. (Used), New York N. Y.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

MACHINERY—Rod Mill
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.

MACHINERY—Rolling Mill
Morgan Construction Co., Worcester, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Rubber Insulating
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Royle, John & Sons, Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Serving
Pourtier Pere et Fils, Romainville (Seine), France
Wardwell Braiding Machine Co., Central Falls, R. I.

MACHINERY—Spark Testing
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Peschel Electronics, Inc., New Rochelle, N. Y.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Staple
Nilson, A. H. Machine Co., Shelton, Conn.
Wafios, Maschinenfabrik, Reutlingen, Wurtt., Germany

MACHINERY—Straightening & Cutting
Breitenbach, Wilhelm, Unna, Germany
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Patterson Machine, Geo. C., Co., Cleveland, Ohio
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Stranding
Bartell Machine-Tool Corporation, Rome, N. Y.
Godderidge Ste., Houilles, (Seine-et-Oise), France
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Stripping Electric Wire & Cable
Burdwood, Howard A., Inc., Portland, Maine

MACHINERY—Swaging
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Take-Up and Pay-Out
American Insulating Mach'y Co., Phila., Pa.
Breitenbach, Wilhelm, Unna, Germany
Colbourne Machine Company, Winsted, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio
Pourtier Pere et Fils, Romainville (Seine) France
Standard Mill Supply Co., Pawtucket, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Testing Magnet Wire Coatings for Pin Holes
Federal Mfg. Co., Wallingford, Conn.
Peschel Electronics, Inc., New Rochelle, N. Y.

MACHINERY—Testing, Physical
Scott Testers, Inc., Providence, R. I.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
Bartell Machine-Tool Corporation, Rome, N. Y.
Cook Manufacturing Co., The, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Universal Industrial Equipment Co., Secaucus, N. J.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill, Cold Drawing
Mettler Machine Tool, Inc., New Haven, Conn.

MACHINERY—Twinning
(See Mach.—Bunching)

MACHINERY—Twisters, Wire
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.

MACHINERY—Used
National Machinery Exchange, New York, N. Y.
Wire & Textile Machy., Inc., Pawtucket, R. I.

MACHINERY—Welded Wire Mesh
E. V. G., Richard Kleinhans, New York, N. Y.
Manco Mfg. Co., Bradley, Illinois
Maschinen & Stahl A. G., c/o Richard Kleinhans, Zurich, Switzerland

MACHINERY—for Wire Welding
(See WELDERS—Butt and Spot and Machinery —Welding Wire Fabrics)

MACHINERY—Winding Wire
Emory Company, Robert J., Newark, N. J.
Federal Manufacturing Company, Wallingford, Conn.
Industrial Winding Machinery Co., New York, N. Y.
New England Butt Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
Breitenbach, Wilhelm, Unna, Germany
Cook Manufacturing Co., The, Paterson, N. J.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Federal Mfg. Co., Wallingford, Conn.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
Morgan Construction Co., Worcester, Mass.
Morgardshammer Mek Verstads AB, Morgardshammer, Sweden
National Mach'y Exch. (Used), New York, N. Y.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

MACHINERY—Wire Forming
National Mach'y Exch. (Used), New York, N. Y.
Nilson, A. H. Machine Co., Shelton, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

MACHINERY—Wrapping with Paper
Larmuth (1947) Ltd., Swinton, England
Terkelsen Machine Co., Boston, Mass.

MANDRELS—Extrusion
Bartell Machine-Tool Corporation, Rome, N. Y.

MATERIAL HANDLING EQUIPMENT—
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MOTORS—Electric, A.C. & D.C.
The Louis Allis Company, Milwaukee, Wisc.

NAIL TOOLING—Tungsten Carbide
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

NAILS—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Brothers, Inc., Cortland, N. Y.

NIPPERS—Wire Cutting
Robinson, M. W. Co., Rockfall, Conn.

NOZZLES—For Extruding Machines
Wire Tool Div., Bridgeport Jig Boring Co., Bridgeport, Conn.

OVENS—Cable Lacquering and Enameling
American Insulating Mach'y Co., Phila., Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Colbourne Machine Company, Winsted, Conn.
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

OVENS—Rod Bakers
Carl Mayer Corp., The, Cleveland, Ohio

OVENS—Welding Rod Coating
Carl Mayer Corp., The, Cleveland, Ohio
Industrial Ovens, Inc., Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio

PAILS—Packaging
(See Drums—Wire Packaging)

PAINT BONDING CHEMICALS—
American Chemical Paint Co., Ambler, Pa.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PAPER—Creped Wrapping
Arkell Safety Bag Company, New York, N. Y.
National Waterproof Papers, Inc., Beverly, N. J.
Rinkle, Krinkle Paper Co., Inc., Boston, Mass.
Terkelsen Machine Co., Boston, Mass.

PAPER—For Coil Wrapping and Corrosion Prevention
Arkell Safety Bag Company, New York, N. Y.
National Waterproof Papers, Inc., Beverly, N. J.
Rinkle, Krinkle Paper Co., Inc., Boston, Mass.
Terkelsen Machine Co., Boston, Mass.

PAPER—Insulating
Plymouth Cordage Company, Plymouth, Mass.
Twitchell, Inc., E. W., Philadelphia, Pa.

PATENT—ATTORNEYS—
Lancaster, Allwine & Rommel, Washington, D. C.

PAY-OUT SYSTEMS—
(See MACHINERY—Take-Up & Pay-Out)

PHOSPHATE COATING CHEMICALS
(See COMPOUNDS—Phosphate Coating)

PICKLING COMPOUNDS—
See (Inhibitors—Pickling)

PLASTICIZERS—
Monsanto Chemical Company, Plastics Division, St. Louis, Mo.
Pittsburgh Coke & Chemical Co., Pittsburgh, Pa.

PLASTICS COMPOUNDING—Custom
Plandex Corporation, Downingtown, Pa.

PLASTICS—for Wire Insulation
Bakelite Company Div. of Union Carbon & Carbide Corporation, New York, N. Y.
duPont de Nemours Co., (Inc.), E. I., Polychemical Dept., Wilmington, Delaware
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Plandex Corporation, Downingtown, Pa.
Shawinigan Resins Corporation, Springfield, Mass.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, New York, N. Y.

POTS—Lacquer
Industrial Ovens, Inc., Cleveland, Ohio

PRINTING WHEELS—for Electric Wire
Entwistle Manufacturing Corporation, Providence, R. I.
Gillies, Duncan M. Co., Inc. Boylston, Mass.

PULLERS AND GRIPS—For Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

PUMPS—Molten Metal
Fisher Associates, New York, N. Y.

RACKS—Wire Storage
Jarke Manufacturing Co., Chicago, Illinois

REEL AND TENSION STANDS—
Industrial Ovens, Inc., Cleveland, Ohio
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Co., Garrett, Ind.
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio

REELS—Metal Bound
Durkee Mfg. Co., Inc., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

REELS—Plywood
Carris Reels, Inc., Rutland, Vt.
Hubbard Spool Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
Nelson Company, The, Baltimore, Md.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

REELS & SPOOLS—Steel (All Types)
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS—Wire Mill
Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
Mettler Machine Tool, Inc., New Haven, Conn.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Nilson, A. H. Machine Co., Shelton, Conn.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Wood
American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
Nelson Company, The, Baltimore, Md.
Strand-Buffalo Corporation, North Tonawanda, N. Y.

REFRACTORIES—High Temperature
Norton Company, Worcester, Mass.

ROD BAKERS—
(See OVENS—Rod Bakers)

RODS—Aluminum
Aluminum Company of America, Pittsburgh, Pa.

RODS—Stainless Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Pittsburgh Steel Co., Pittsburgh, Pa.

RODS—Wire—Non-Ferrous
Aluminum Company of America, Pittsburgh, Pa.
Platt Bros. & Co., The, Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.
Seymour Mfg. Co., Phosphor Bronze Div., Seymour, Conn.

RODS—Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

ROPE—Wire
Bethlehem Steel Co., Bethlehem, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.

RUST PROOF COMPOUNDS—
(See COMPOUNDS—RUST Preventing)

RUST REMOVING COMPOUNDS—
(See COMPOUNDS—RUST Preventing)

SATURATION SYSTEMS—
Industrial Ovens, Inc., Cleveland, Ohio
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

SHEARS—Wire, Rod, Billet
Manco Mfg. Co., Bradley, Illinois

SOAPS—Industrial and Wire Drawing
(See COMPOUNDS—Wire Drawing)

SPOOLS—Plastic
Hubbard Spool Company, Garrett, Indiana
Standard Mill Supply, Co., Pawtucket, R. I.

STAMPINGS—Steel
Acrometal Products, Inc., Minneapolis, Minn.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STOCK STORAGE SYSTEMS
Jarke Manufacturing Co., Chicago, Illinois

STRAIGHTENERS—Portable Rod
Manco Mfg. Co., Bradley, Illinois

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

SWITCHES—Electronic Sensing
Winstrom, Northampton, Mass.

TABLES—Press Feeding
Jarke Manufacturing Co., Chicago, Illinois

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TESTERS—INSULATION
(See MACHINERY—Spark Testers)

TESTING EQUIPMENT
(See MACHINERY Testing, Physical and Diameter Testing)

TINSEL—Electric Conductor
Montgomery Co., The, Windsor Locks, Conn.

WHERE TO BUY, Continued

For more complete information, consult the annual Wire and Wire Products Buyers' Guide.

TINSEL WIRE—Resistance, Lame, Decorative Cords Thread—Bare Copper Silver and False Gold Coated, etc.
(See TINSEL—Electric Conductor)

TOOLS—Nail Machine
Pittsburgh Carbide Die Co., Monongahela, Pa.

TOOLS—Wire Cutting
Porter, H. K., Inc., Somerville, Mass.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TRANSMISSIONS—Variable speed (See Adjustable Speed Drives)

TRAVERSES & DRUMS—For Reels
(See Drums & Traverses)

TRAVERSE MECHANISMS—
Apco Mossberg Co., Attleboro, Mass.
Bartell Machine-Tool Corporation, Rome, N. Y.
Emory Company, Robert J., Newark, N. J.
Hodge Bros. Machine Shop, Ossining, N. Y.
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

VARNISHES & LACQUERS—for Electric Wire
General Electric Company, Alkanex Wire Enamel Dept., Schenectady, N. Y.
Shawinigan Resins Corporation, Springfield, Mass.

VULCANIZING PANS AND EQUIPMENT—
American Insulating Mach'y Co., Phila, Pa.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt and Welding Wire Fabrics
Eisler Engineering Corp., Newark, N. J.
Micro Products Co., Chicago, Ill.
Strecker, August, K.G., Limburg/Lahn, W. Germany

WHEELS—for Printing on Electric Wire
Gem Gravure Company, West Hanover, Mass.

WIRE—Aluminum
Aluminum Company of America, Pittsburgh, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Malin & Co., The, Cleveland, Ohio
National Standard Company, Niles, Mich.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Ball
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Barbed
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

WIRE—Brass and Bronze
Chase Brass & Copper Co., Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.
Seymour Mfg. Company, Phosphor Bronze Div., Seymour, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Cadmium
Stamford Processing Co., Peekskill, N. Y.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Cold Heading
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Steel Corp., Kansas City, Mo.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Copper
Chase Brass & Copper Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—For Electrical Conductors
United Wire & Supply Corporation, Providence, R. I.

WIRE—Flat, Fine
Montgomery Co., The, Windsor Locks, Conn.
National Standard Company, Niles, Mich.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Galvanized
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
National Standard Company, Niles, Mich.
Roebling's, John A. Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—High Carbon
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Manufacturers
Aluminum Company of America, Pittsburgh, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Brass & Copper Co., Waterbury, Conn.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
National Lock Washer Company, The, Newark N. J.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Porter Company, Inc., H. K., Riverside Alloy Metal Division, Prospect Park, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Scovill Mfg. Co., Waterbury, Conn.
Seymour Mfg. Company, Phosphor Bronze Div., Seymour, Conn.
Sheffield Steel Corp., Kansas City, Mo.
United Wire & Supply Corporation, Providence, R. I.
U. S. Steel Corp., N. Y., N. Y.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Metalizing
Platt Bros. & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

WIRE—Music
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., The, Cleveland, Ohio
National Standard Company, Niles, Mich.
Worcester Wire Works Div., National-Standard Company, Worcester, Mass.

WIRE—Needle
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Nickel Alloy
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.

WIRE—Nickel Silver and Phosphor Bronze
Chase Brass & Copper Co., Waterbury, Conn.
Malin & Co., The, Cleveland, Ohio
Porter Company, Inc., H. K., Riverside Alloy Metal Division, Prospect Park, Pa.
Seymour Mfg. Co., Phosphor Bronze Div., Seymour, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Oil Tempered
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Special Shapes
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
National Lock Washer Company, The, Newark, N. J.
Porter Company, Inc., H. K., Riverside Alloy Metal Division, Prospect Park, Pa.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Spring
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Crucible Steel Co. of America, Pittsburgh, Pa.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Porter Company, Inc., H. K., Riverside Alloy Metal Division, Prospect Park, Pa.
Roebling's John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Stainless Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Crucible Steel Co. of America, Pittsburgh, Pa.
Firth Sterling, Inc., Pittsburgh, Pa.
National Lock Washer Company, The, Newark, N. J.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Steel—Also Coppered and Galvanized Steel
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Crucible Steel Co. of America, Pittsburgh, Pa.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Porter Company, Inc., H. K., Riverside Alloy Metal Division, Prospect Park, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Steel Corp., Kansas City, Mo.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Straightening and Cutting
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

WOOD—for Guide, Rolls, Bushings, Wear Parts, etc.

WRAPPING PAPER—Creped
(See PAPER—Creped Wrapping)

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

The WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON 3, NEW JERSEY, U. S. A.

ELECTRICAL WIRE AND CABLE, WIRE ROPE, CORDAGE
AND MASTICATING MACHINERY MANUFACTURERS

WATSON

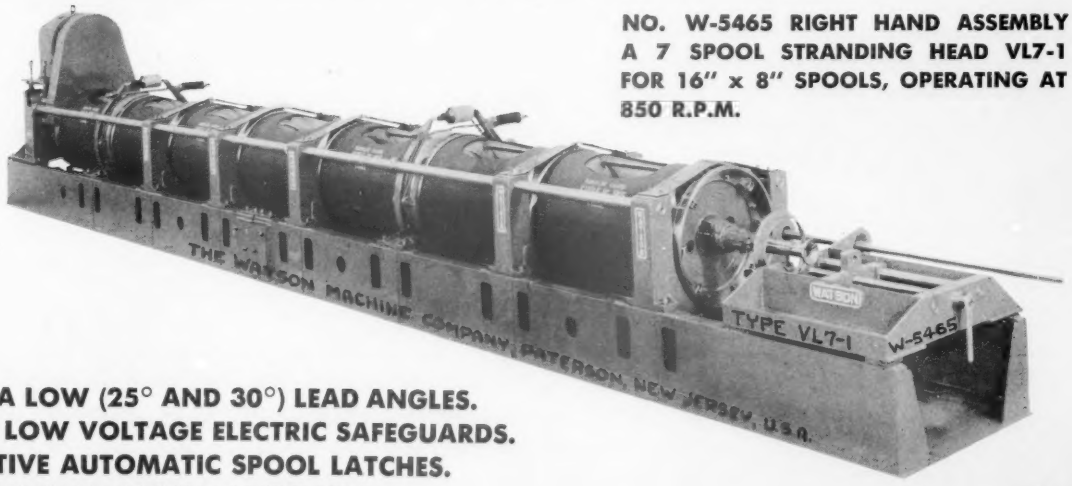
EXTRA HIGH SPEED STRANDERS TYPE "VL"

U. S. Patents 2,270,093, 2,442,817 & 2,690,642

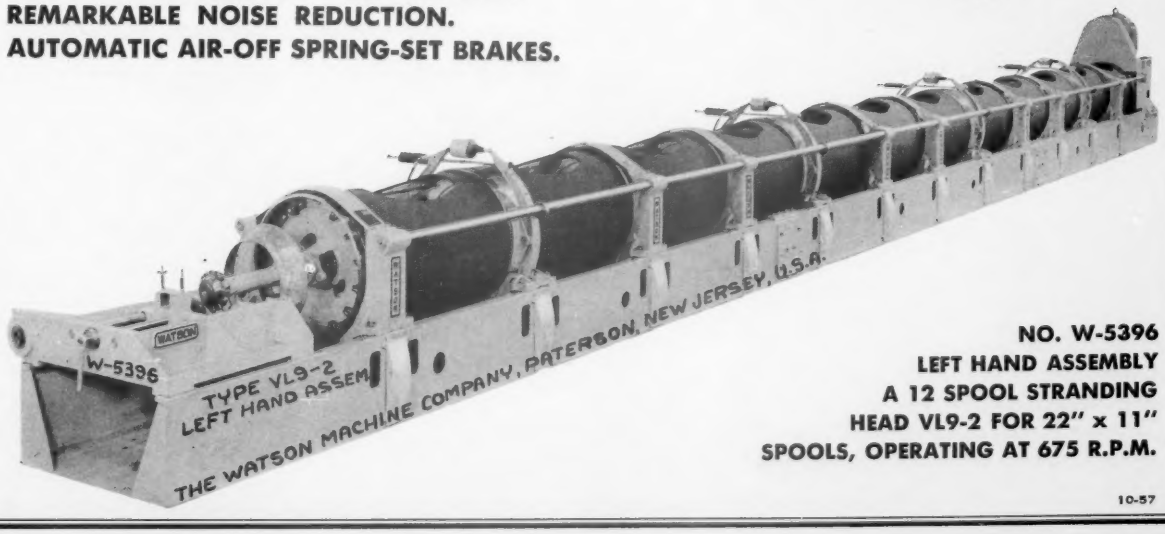
THIS OUTSTANDING DESIGN REPRESENTS THE ULTIMATE IN EFFICIENT PERFORMANCE UNDER THE MOST SEVERE OPERATING CONDITIONS. IT IS NOW AVAILABLE IN ALL SIZES AND COMBINATIONS FOR SPOOLS FROM 5 TO 1000 POUND CAPACITY.

IN IT ARE COMBINED: HIGHEST POSSIBLE SAFE ROTOR SPEEDS. PATENTED NO-LOOSE-PART-INTEGRAL FRICTION "SHAFTLESS" CRADLES, WHICH REDUCE LOADING TIME TO A MINIMUM, ELIMINATE ACCIDENT HAZARDS AND CONTRIBUTE TOWARDS THE OPERATORS CONVENIENCE. A PRACTICALLY MAINTENANCE-FREE, PATENTED TUNGSTEN CARBIDE OR HARD CERAMIC WIRE GUIDE SYSTEM. A PATENTED "SPINNING" CRADLE NOSE CENTER GUIDE WHICH DISTRIBUTES WEAR AND GREATLY REDUCES WIRE "CURLING".

NO. W-5465 RIGHT HAND ASSEMBLY A 7 SPOOL STRANDING HEAD VL7-1 FOR 16" x 8" SPOOLS, OPERATING AT 850 R.P.M.



EXTRA LOW (25° AND 30°) LEAD ANGLES.
NEW LOW VOLTAGE ELECTRIC SAFEGUARDS.
POSITIVE AUTOMATIC SPOOL LATCHES.
REMARKABLE NOISE REDUCTION.
AUTOMATIC AIR-OFF SPRING-SET BRAKES.



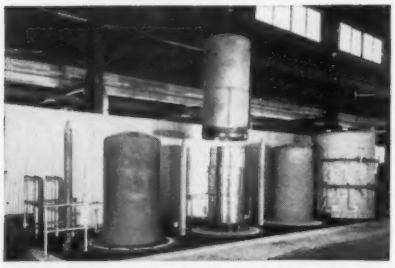
NO. W-5396 LEFT HAND ASSEMBLY A 12 SPOOL STRANDING HEAD VL9-2 FOR 22" x 11" SPOOLS, OPERATING AT 675 R.P.M.

10-57

Part of an installation of large gas fired three-stack rectangular bell type forced circulation special atmosphere furnaces for annealing strip.

Bell Type FURNACES

Built to Suit Your Plant, Product or Process



Built right—over 20 years ago—this EF installation is still in operation, daily—and producing first class work.

Single or multi-stack — circular, rectangular or square types — upright, elevator or partial pits — gas fired, oil fired or electric — correctly designed, built and installed, ready to produce.

Backed by over 40 years of practical furnace building experience, EF furnaces incorporate all the advantages of all bell type designs, for processing strip, wire, rod and other ferrous and non-ferrous products.

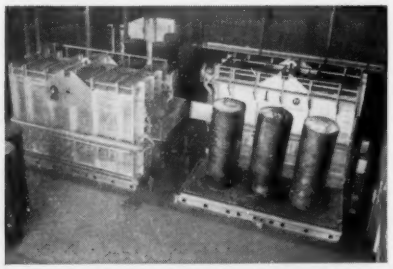
EF bell type furnaces installed over 20 years ago are still in service daily, producing first class work. After all, there's no substitute for experience. At your convenience EF experienced engineers will be pleased to discuss the best type for your specific requirements.

EF direct gas fired forced circulation bell type furnace for processing wire, rod, strip and other products. The split cover design permits installing where head room is limited.

THE ELECTRIC FURNACE CO.
GAS FIRED, OIL FIRED AND ELECTRIC FURNACES FOR ANY PROCESS, PRODUCT OR PRODUCTION
Salem - Ohio
Canadian Associates • Canefco Limited • Toronto 1, Canada

EF direct gas fired special atmosphere forced circulation, single stack circular bell steel strip annealers, each accommodates three 48" x 40" 15,000 lb. coils (45,000 lbs.)

Part of another installation of large EF gas fired three-stack rectangular bell type forced circulation special atmosphere furnaces for annealing steel strip.



EF gas fired special atmosphere rectangular bell type strip annealers with individually controlled forced circulation three-stack bases each with capacity of 135,000 lbs. per charge.